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Microsoft reorg solidifies role of Surface, HoloLens, and other devices to sell Windows

By uniting its Windows and Devices group under Terry Myerson, Microsoft wants closer control over the entire user experience.

BY JARED NEWMAN

Microsoft recently reorganized with a bang. It ousted big-name executives Stephen Elop and Mark Penn. It gave Windows leader Terry Myerson the Devices group that Elop once led. Driving these and other dramatic changes are a fundamental corporate shift that wasn't explicitly stated: At the modern Microsoft, hardware is now a very big deal.

The reorganization encompasses most aspects of Microsoft's business, tossing out some of Microsoft's most noteworthy executives



Terry
Myerson

in the process. Stephen Elop, who led Nokia and oversaw its integration with Microsoft, is out. Ditto for Mark Penn, the controversial political operative who was instrumental in Microsoft's "Scroogled" campaign.

Instead, Microsoft now sees its "mobile first, cloud first" vision from chief executive Satya Nadella organized around three initiatives: to reinvent productivity and business processes, to build the intelligent cloud platform, and to create more personal computing.

Instead of different business units governing hardware and Windows, Microsoft now has placed them under one roof: Terry Myerson will oversee the Windows and Devices Group, combining the Operating Systems Group and the Microsoft Devices Group that Elop formerly helmed.

"WDG will drive Windows as a service across devices of all types and build all of our Microsoft devices including Surface, HoloLens, Lumia, Surface Hub, Band and Xbox," Nadella said in an email to employees. "This enables us to create new categories while generating enthusiasm and demand for Windows broadly."

Windows as a service is an evolution that Microsoft has talked about

Satya Nadella
(left) and
Stephen Elop
(right), in happier
times.





for some time, although it still hasn't clarified its vision: whether Microsoft will ask future Windows PC owners to pay on an annual, rather than a one-time basis, or simply continue to add security updates and new features over time, as it's emphasized over the past few months. And no, that aspect will be critical to how you engage with Microsoft and its products in the future.

But Microsoft hasn't said what it plans to do in that regard. What it is saying now is that hardware matters. A lot.

Microsoft's Surface Pro 3 and Surface 3 launched Microsoft into the productivity hardware business.

Why Microsoft now cares about hardware

Scott Guthrie will lead the Cloud and Enterprise team, focused on Microsoft's server-side offerings, while Qi Lu will continue to oversee the Applications and Services Group that encompasses Office and related productivity products. But, chances are, it's the new WDG group that you'll be thinking of when you think of Microsoft.

Historically, of course, Microsoft developed Windows, and you bought a PC to run Windows on. Under the new vision, Microsoft not only wants you to buy a PC to run Windows on, but also a Surface tablet, a Microsoft-powered smartphone, and a Surface Hub to connect it to while at the office. Oh, and a Band, too, to remind you of your upcoming meetings. No, there's no reason to believe that Microsoft will stop promoting its products on other ecosystems. But

Microsoft's hardware business now enjoys a pride of place that it never did before.

"This is a recognition of the new market reality that the OS is part of the device and the device experience

depends on the OS," said Steve Kleynhans, an analyst with Gartner, in an email. "Users no longer distinguish between the device and its operating system so there needs to be close alignment between the hardware and the OS."

In other words, Windows isn't just synonymous with Microsoft applications like Office, but with Microsoft's hardware as well.

This shouldn't come as a great surprise. Both of the first two Surface Pro generations had a sense of the prototype about them, as Microsoft took lessons it had learned in the game console business and applied them to the general productivity market. But the Surface Pro 3 launch was Microsoft's debutante ball, where it confidently strode into the hardware space.

Nadella said then that Microsoft's goal was not to compete with its OEMs, but to "create new categories and spark new demand for our entire ecosystem". According to Kleynhans, "Microsoft's hardware division is about showcasing the best user experience using Microsoft technology, so combining these two makes sense to ensure the two groups leverage each other as the OS and devices evolve."

Some feel, however, that the reorganization elevates Windows

Under the new vision, Microsoft not only wants you to buy a PC to run Windows on, but also a Surface tablet, a Microsoft-powered smartphone, and a Surface Hub to connect it to while at the office.




The face of

Windows: Terry Myerson.

again, as Directions on Microsoft's Wes Miller does. "To me it is the sign that hardware and software are at best peers, but also that the software and experiences will likely drive the hardware—and ensure a stronger relationship with OEM partners again," Miller said in an email.

I tend to believe that Microsoft didn't set out to create the best user experience for Windows, but the best Windows devices, period, setting the pace for its hardware partners to follow. If they do, great. If not, the industry will move forward without them. It's a bold, ambitious vision, and one that's been absent from the computer industry. HoloLens, the Surface Hub, and the Xbox One together move the industry forward. Can one man, Myerson, oversee all that? As Kleyhans notes, it's a tremendous vote of confidence in Myerson, in Windows 10, and in Myerson's vision for it all.

But here's the bottom line: yes, you'll still be able to choose whatever PC you want to run Windows 10. But now, more than ever, Microsoft cares whose name is on the box. 

About the only
weak point in
Microsoft's
Windows
ecosystem is the
Microsoft Band,
which doesn't run
Windows. Is a
Windows 10
powered Band on
the horizon?





Toshiba will build a Cortana button into its Windows 10 laptops

BY MARK HACHMAN

CORTANA WILL BE ONE OF THE major features (go.pcworld.com/new10) to come to Windows 10, and at least one PC vendor plans to treat her especially well. Toshiba's Windows 10 laptops will feature a dedicated Cortana button, for launching Microsoft's digital assistant from your keyboard.

The Cortana key will be on all of Toshiba's Windows 10 PCs—"across the board, top to bottom," according to Jeff Barney, the general manager and vice president in charge of Toshiba America's PC business. The key will sit in the upper left area, near the function keys,

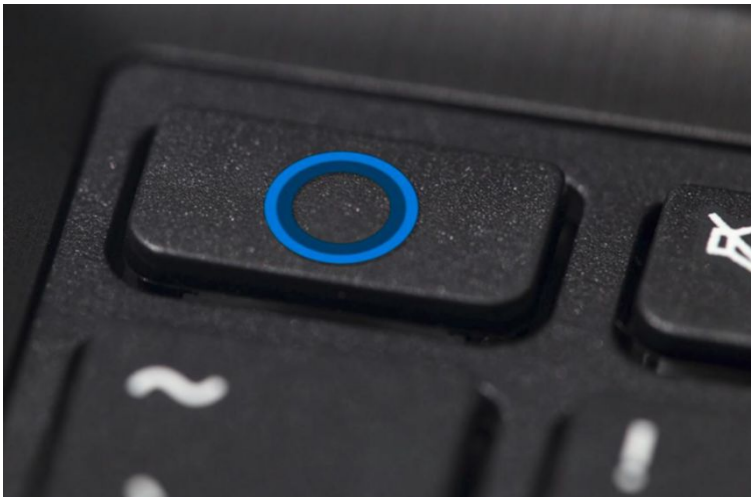
he said. Triggering it will launch Cortana, Microsoft's digital assistant.

Cortana was first introduced as part of the Windows Phone platform as a way for users to interact with the operating system without using a keyboard. Tapping and holding the phone's search key triggers the service, which can respond to oral questions, set reminders, navigate to nearby locations, and perform a number of other tasks when verbally requested. With Windows 10, Cortana will live inside desktop PCs as well as phones and tablets.

But on both the phone and the PC, Cortana's ability to "actively listen" has been problematic (go.pcworld.com/hey), with difficulty picking up and reacting to the use of the "Hey Cortana" phrase that triggers it. In practice, it's been far more successful when manually triggered.

The idea behind the dedicated Cortana button, Barney said, is to make sure that "Cortana is listening when you want it to." The company has added high-fidelity array mics to its PCs to improve Cortana's ability to understand what you say.

Why this matters: If a user wants to use the Cortana feature on Windows 10, he or she has either had to tap the Cortana icon on the



An artist's mock-up of what Toshiba's Cortana button might look like. (Photo illustration by Rob Schultz.)


screen or move the mouse to trigger the service. Placing a dedicated Cortana button on the keyboard is a smart idea, especially if the service proves to be a hit. Frankly, I'd be willing to bet that Microsoft also releases a mouse that does the same thing. (Logitech, a rival peripherals maker, declined to comment.)

One small click for Toshiba, one giant leap for the keyboard

A dedicated Cortana key would be one of the more significant changes to the keyboard since the Windows key was added at about the time Windows 95 was introduced, in 1995. Although Microsoft added touch support for Windows 8, most external monitors still don't support it, leaving the mouse and keyboard as the most popular ways of interacting with your PC.

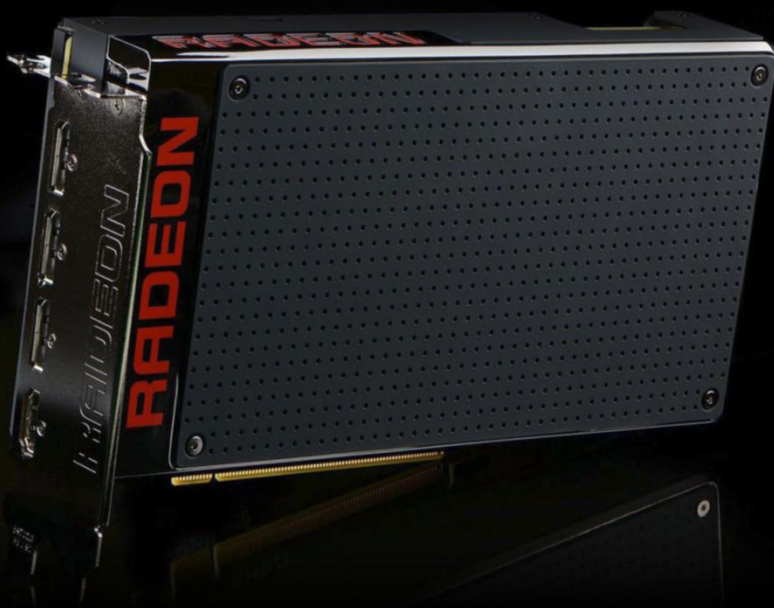
Voice commands could help change that. Even with a keyboard dock, a dedicated hardware Cortana button would be within easy reach of a PC user's hands. (IDG News Service reporter Blair Hanley Frank also notes that the Windows key + C combination also launches Cortana.)

As Bob O'Donnell of TECHanalysis Research points out, Toshiba is a niche PC vendor—fifth in the United States, with a 6.5 percent share, according to IDC—that could use an idea like this to distinguish itself from the competition. And the company may do just that: So far, no other PC vendor, including Hewlett-Packard and Dell, have publicly indicated that they, too, plan to use a hardware-based Cortana button.

O'Donnell said he's installed Windows 10 on a Surface Pro 3 and an HP Spectre, and found that the Cortana integration was "just OK." O'Donnell has hardly given up on Cortana at this point, though. "It's hard to pass judgement on that," he said. "They're going to keep working on it up until the last minute." 

Behold the beast: Full AMD Radeon R9 Fury X tech specs and design details revealed

BY BRAD CHACOS



AMD'S FORMAL UNVEILING of the beastly new Radeon R9 Fury X (go.pcworld.com/r9) at E3 this year revealed a lot about the graphics card, but several technical details were left glaringly undetailed. Now, AMD's taking the wraps off the rest of the information, giving us a full profile of its impressive new \$650 flagship—a flagship where just as much care was spent on aesthetics as on raw technological firepower.

For information about the rest of AMD's new Radeon R300 series cards,

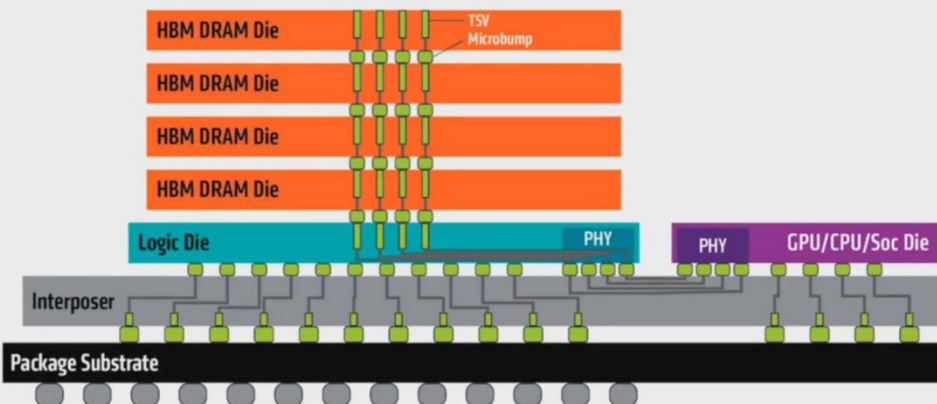
which have been released, go here: go.pcworld.com/r300.

We'll go through it all in detail, but let's kick things off with the premier feature: The Fury X's revolutionary high-bandwidth memory.

Traditional dies for GDDR5 DRAM need to be arrayed on the board around the graphics processor, which sucks up a ton of space on the card. HBM is a new technology that stacks DRAM vertically instead, connecting the dies and the GPU via interposers. You can read all about HBM here (go.pcworld.com/hbm), but in a nutshell, it requires far less room on the graphics card and also delivers a ton of memory bandwidth, by pairing low clock speeds with a ridiculously wide memory interface.

Specifically, the HBM in the Radeon R9 Fury X is clocked at a mere 1Gbps. That may seem paltry when compared to the 7Gbps speeds standard to the traditional GDDR5 memory in Nvidia's flagship graphics cards. But Nvidia's GDDR5 memory travels over a 384-bit-wide interface, which the Fury X's 4GB of HBM utilizes a 4,096-bit bus. Yes, you read that correctly. That combination gives the Fury X 512GBps of total memory bandwidth, compared to the ferocious GTX 980 Ti's 336.5GBps (go.pcworld.com/ferocious).

AMD's High Bandwidth Memory (HBM) design



Craziness.

HBM's drastically reduced footprint also lets AMD pack a ton of tech into its new Fiji GPU—literally. Fiji rocks 4,096 stream processors and 8.9 billion transistors, compared to the older R9 290X's 2,816 stream processors and 6.3 billion transistors. (Nvidia's Titan X packs 8 billion.) Clocked at up to 1,050MHz, it's able to pump out up to 8.6 teraflops of compute performance. You can see the full tech specs for the Fury X's HBM and Fiji processor in the chart at right.

All that power needs a pair of 8-pin connectors and 275 watts from the wall under heavy gaming scenarios, which is similar to the 980 Ti's needs. (Nvidia's card asks for 250W).

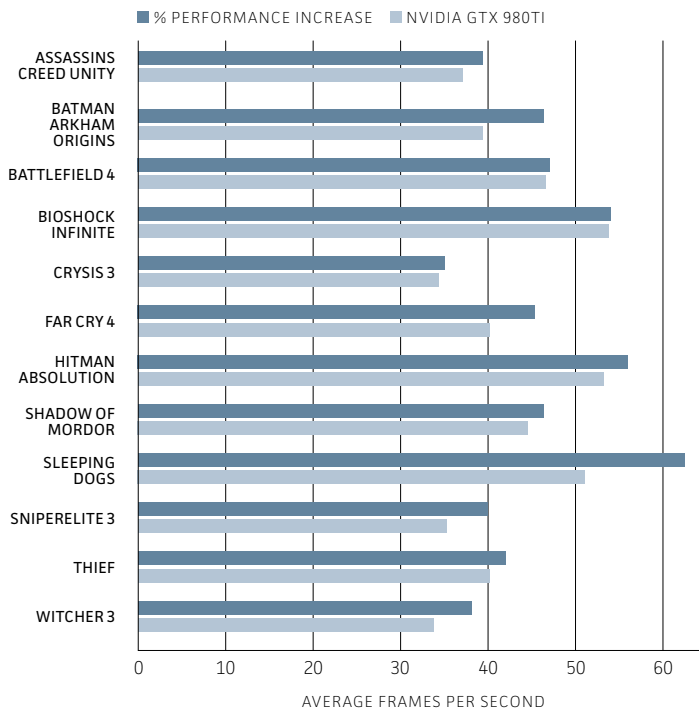
So now for the elephant in the room: How does the Fury X compare to Nvidia's similarly priced GeForce GTX 980 Ti? It's impossible to tell until we've put the Radeon through its review

paces, given that AMD's stream processors and Nvidia's CUDA core technology aren't directly comparable, and HBM adds an unknown factor. But the AMD-supplied benchmarks on the next page—which were obviously chosen to place the Radeon in the best possible light—show the two cards performing fairly neck-and-neck in most games.

AMD Radeon R9 Fury X tech specs

	AMD Radeon R9 Fury X Series
Process	28nm
Stream Processors	4096
Engine Clock	Up to 1050MHz
Compute Performance	8.6 TFLOPs
Texture Units	256
Texture Fill-Rate	268.8 GT/s
ROPs	64
Pixel Fill-Rate	67.2 GP/s
Z/Stencil	256
Memory Configuration	4GB HBM
Memory Interface	4096-bit
Memory Speed / Data Rate	500Mhz / 1.0Gbps
Memory Bandwidth	512 GB/s
Power Connectors	2 x 8-pin
Typical Board Power	275W
PCI-E Standard	PCI-E 3.0
API Support	DirectX 12, Vulkan, Mantle
FreeSync Support	Yes
Virtual Super Resolution	Yes
Frame Rate Targeting Control	Yes

4K Gaming Performance Benchmarks



AMD-supplied benchmark results pitting the Radeon Fury X against Nvidia's GeForce GTX 980 Ti in several games at 4K resolution.

You'll find the graphics settings AMD used in each game here (imgur.com/oxQaUWJ).

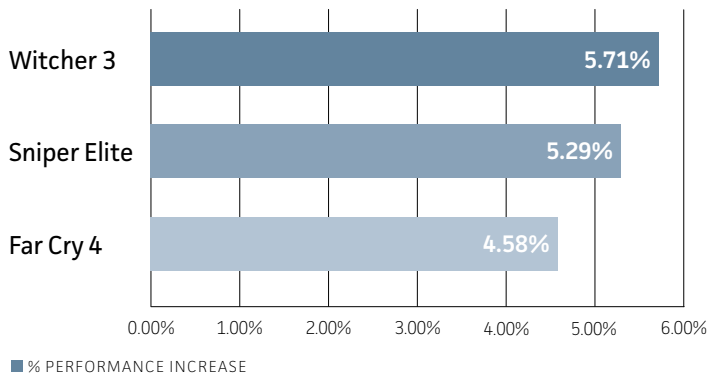
But the liquid-cooled Fury X was made to be overclocked. "You'll be able to overclock this thing like no tomorrow," AMD CTO Joe Macri said at the card's unveiling. "This is an overclocker's dream." So on the next page are more AMD-supplied benchmarks showing performance gains in various games after a 100MHz overclock is applied to the Fury X.

Remember: That's all with the Radeon R9 Fury X being water-cooled—Nvidia's 980 Ti relies on air. You have to wonder how the benchmarks will shake out when the air-cooled Radeon R9 Fury launches July 14. Hey! That's a nice segue to...

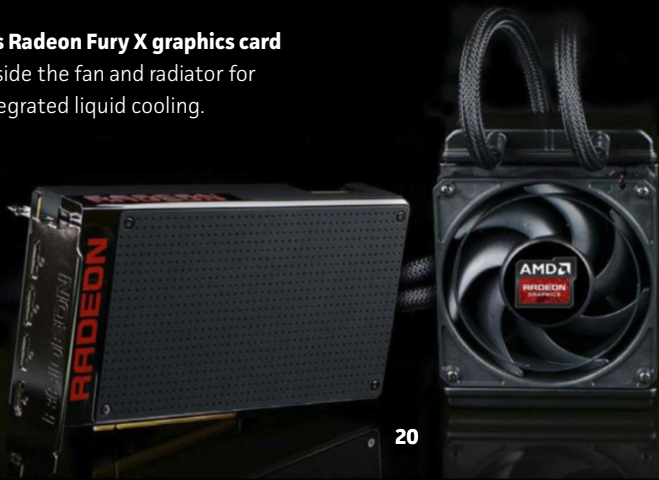
AMD's new flagship draws a lot of design cues from the Radeon R9 295x2, AMD's immensely powerful dual-GPU graphics card from the R200 series generation.

As mentioned, the Radeon R9 Fury X sports a fully integrated water-cooling solution. It cools all elements of the graphics card, eliminating the need for a fan on the card's board, which allowed AMD to eliminate the grill on the rear port bracket and extend the shroud to the sides of the graphics card—an area left open in many graphics

Overclock Performance



AMD's Radeon Fury X graphics card alongside the fan and radiator for its integrated liquid cooling.



card designs. Locking down the card so tightly prevents heat from your other PC components from interfering with the Fury X's cooling, AMD representatives said.

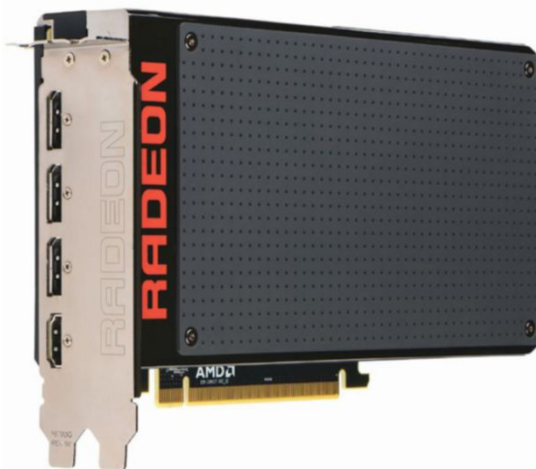
The closed-loop liquid cooling solution itself is a custom design dreamed up by AMD and Cooler Master, paired with a 120mm Nidec Gentle Typhoon on the radiator. That fan can spin up to 3000 rpm, though representatives say it mostly spins at a much quieter 1500 rpm. AMD claims the liquid cooling keeps temperatures at a chilly 50 degrees Celsius—similar performance to the Radeon R9 295x2's integrated liquid cooling (go.pcworld.com/liquidec)—with noise levels around 35 decibels. Hey overclockers: AMD says this cooler supports up to 500 watts of thermal capacity.

In case it isn't obvious yet, the Fury X uses a very unique design. So unique, in fact, that AMD's add-in board partners (like Asus, MSI, and Sapphire) won't be able to customize the card with their own cooling solutions. The Fury X will be reference design-only, though AIBs will be able to tinker with the air-cooled Radeon R9 Fury in July.

That means all Fury X cards will be physically similar no matter which manufacturer you buy from.

The Fury X measures a mere 7.5 inches long, or 30 percent shorter than the older R9 290X. It's constructed of multiple pieces of die-cast black nickel aluminum, finished with a mirror gloss on the exoskeleton and black soft-touch on the side plates. Removing four hex screws will let you take off the shroud; the Fury X also features a full backplate. (Yes!)

Port-wise, you'll find three full-size DisplayPorts as well as an HDMI



1.4a connection. AMD learned the folly of the Radeon R9 295x2's heavy reliance on Mini-DisplayPort connections, it seems, though the lack of HDMI 2.0 means you'll be limited to 30Hz when pushing 4K video through that port. The Fury X is capable of driving up to six displays simultaneously, though doing so would obviously require a DisplayPort hub.

You'll find an LED-illuminated Radeon logo on the face and outer edge of the card, as well as a new feature: 8 small lights located above the 8-pin power connectors. Dubbed "GPU tach" (as in "tachometer") by AMD, more of these lights will flare to life the harder you push your graphics card—a nifty gimmick, though I'm not sure that cranking it to 8 has quite the same allure as cranking it to 11. A ninth green LED will illuminate when the GPU is put to sleep by AMD's ZeroCore technology.

Speaking of cranking it to 11—er, 8—AMD's PR keeps stressing that the Fury X will be a kick-ass overclocker. The card's design speaks to that, featuring a dual BIOS switch, 6-Phase power design with up to 400 amps of power delivery, and AMD's standard SVI2 interface to the voltage regulator, which sports full telemetry readback and lets you tinker with power settings via AMD's PowerTune. (If you didn't understand any of that, don't sweat it—they're hard-core overclocking features.) And while the Fury X typically draws just 275W of power while gaming, the dual 8-pin connectors support up to 375W. Read: OVERCLOCK ME.

Finally, the Fury X supports all the software features you'd expect: the next-gen DirectX 12 and Vulkan APIs, FreeSync, Virtual Super Resolution, the aforementioned PowerTune, and AMD's new frame

The AMD Radeon R9 Fury X's backplate, side shroud, and power pins (with "GPU tach" lights).





rate targeting control, which allows you to set a maximum frame rate output to reduce power draw and, by association, noise output. Here are more AMD-supplied benchmarks showing FRTC in action:

Framerate Target	Average FPS achieve in Campaign Intro	Total System Power Draw during Campaign Intro	Average FPS during gameplay	Total System Power Draw during gameplay
Unconstrained/disable	310 fps	355-390W	105 fps	344W
80 fps	78 fps	167 fps	79 fps	283W
60 fps	59 fps	151 W	59 fps	242W

How does it feel?

There you have it: Every single tech spec you need to know about AMD's new flagship, the water-cooled Radeon R9 Fury X. Of course, all the tech specs in the world don't mean a thing next to the numbers that really matter: Benchmark results.

The Fury X walks the spec walk, but can it talk the performance talk about Nvidia's similarly priced GeForce GTX 980 Ti? That remains to be seen. But we'll no doubt have the answer sooner rather than later, considering that the Radeon R9 Fury X has already hit the streets. 🔌

Oculus announces new Touch and details first games for the consumer-edition Rift

BY HAYDEN DINGMAN

“SO...WHEN’S THE CONSUMER VERSION of the Rift coming?” I’ve been asking Oculus that question since the first time I strapped one over my eyes, and every time cofounder Nate Mitchell would give me a rueful shake of the head. “We don’t know. It’s coming.”

But we know: It’s Q1 2016. And thus it’s high time for Oculus to discuss what consumers will actually get their hands on next year and bring to an end this long and winding road. It’s a road that’s seen VR turn from a novelty into an arms race, that’s seen Oculus go from “easy frontrunner” to jockeying for position with Valve, that’s seen the fledgling company bought by Facebook of all things.

It’s been weird.



At an Oculus press conference in San Francisco, we got our first real details about the consumer version of Oculus Rift (oculus.com), informally known as “Consumer Rift.”

The big news is a new control scheme designed for virtual reality: Oculus Touch. More on that later.

Sitting-down VR

Unlike Valve and HTC’s Vive, the consumer version of the Rift features no wall-mounted IR base stations, no packed-in wands. Instead, like the DK1 and DK2 models it’s a mostly self-contained unit, with the addition of the key “Crescent Bay” prototype features (go.pcworld.com/crescent)—namely, built-in headphones with positional audio. And there’s a new feature: The headphones are removable, rather than merely bending out of the way.

The DK2’s positional-tracking camera also makes a return, though it looks quite a bit sleeker—and it apparently sits on a big stand on your desk, instead of on your monitor. Aiding the camera, the headset itself is now equipped with trackers all the way around, as seen on Crescent



The new
camera
design.



Bay, which will make a huge difference for those who've used DK2—no more “I turned my head too far and the camera lost me” situations.

But the most important changes are presumably related to the Rift's screen—and we still haven't seen it. In the Consumer Rift

announcement we were told it'll run dual displays totaling a 2160 x 1200 resolution at 90Hz—“maybe not the resolution you may one day want,” said CEO Brendan Iribe, but he deemed it a good start. I'm most excited about a totally extraneous feature though: You can now adjust focus with a built-in dial instead of needing to swap out lenses. About time.

In any case, it's an evolution on its predecessor, not exactly a “me-too” bid against Valve and the Vive. This is about refining the DK2, not pivoting toward standing-VR.



The Windows connection

As part of that refinement, Oculus announced a partnership with Windows—both on the OS side and the hardware side. First of all, the Consumer Rift will work natively with Windows 10. That's a pretty huge deal, considering what a pain it is to set up the current DK2.

The Oculus Rift will also ship with a wireless Xbox One controller. In other words, Oculus's baseline control scheme is basically the same thing we've already been doing for the last two years.

That's probably not going to make Oculus go mainstream, though. Put a standard gamepad into a non-gamer's hands and they freeze up. Put one in their hands while their eyes are covered and you're basically asking the impossible of them. To say nothing of the fact that an Xbox controller has nowhere near the same immersive capabilities as the Vive's hand-simulating wands, or the Razer Hydra, Leap Motion, or basically any of the VR-specific control schemes we've seen released in the last two years.

For that you'll need...

Oculus Touch

The big revelation at the press conference was Oculus Touch—basically the Vive's wands, but...rings. They track your hands so you can use them in virtual reality.





Oculus Touch will track your hand movements so you can use them in virtual reality.

There are some interesting capabilities here: For instance, Oculus cofounder Palmer Luckey said the big ring things are used to understand what position your fingers are in, which sounds pretty interesting. You can give a thumbs-up or point or (I assume) flip people the bird. There are also analog sticks, as you might expect, for more traditional controls.

I don't know how they'll feel, though. My first instinct is that they look goofy, but considering Oculus hired a bunch of talent that worked on the Xbox 360 controller (a.k.a. the most comfortable controller I've ever used) I'm reserving official judgment until I see/feel how Touch works in a real-world environment.

More VR games are coming

Finally, Oculus trotted out a bunch of VR games from CCP, Insomniac, and others—plus its virtual storefront, Home.

Oculus Home launches as soon as you put on the Rift, similar to the store on Samsung's Oculus-powered GearVR. The interface is VR-ready, meaning no more fumbling with a mouse and keyboard while trying to peek at your desktop. Oculus's Nate Mitchell said we'll hear more about Home at Oculus's annual Connect conference in September.

As for the games themselves...

CCP showed off EVE Valkyrie again, which of course is an Oculus launch title and...well, something we've been seeing for two years now (go.pcworld.com/2years). It's still fantastic, but you probably already know how you feel.

[Disclosure: My roommate works with CCP as part of the external PR team through LewisPR.]

Insomniac showed off Edge of Nowhere, a third-person science fiction game. I have no idea how it plays on the Rift because 2D trailers aren't great at conveying VR experiences, but hey—I'm willing to give it the benefit of the doubt. At least it looks cool.

A third game, Chronos, showed a brief trailer—again, in third-person. And again, I don't know how it plays. It looks like it involves moving around a labyrinth.

At least we saw a few games, though—and all of them will be available next year. That's the one big thing that Oculus has going for it right now: We need games, we need experiences to show off VR that aren't just hobbyist demos—and Oculus has them, thanks to

No comment.




staffing up on the dev side.

Prepare for an Oculus-Valve VR smackdown

Now, the big question is whether it's enough to beat Valve? And the answer: I honestly don't know. I'll admit: After trying the Vive, I'm a bit disappointed by the Rift's lack of get-up-and-walk-around VR. On the other hand, Valve's device is probably going to cost quite a bit more and require a lot of space to take full advantage. The Rift is pretty easy to get up and running with.

And of course, there's also the release date issue. The Vive is expected to launch later this year. The Rift won't launch until early 2016. Oculus doesn't seem too worried, but I can't help but wonder what sort of effect launching first will have on the competition. It's ambiguous. I honestly don't know which will come out on top.

Either way, I'm excited. We're near the point where these devices will be real. They'll be things you can touch, buy, and play with instead of simply words on a page. Will people embrace virtual reality? Will it overcome the stigmas, silence the naysayers, and become (as I hope) the future (or at least part of the future) of gaming?

We'll see. I'll have hands-on impressions of the Consumer Rift literally as soon as I can strap one to my face. Stay tuned to PCWorld for more! 

Nest Labs revamps its entire product line: Goodbye Dropcam, hello Nest Cam

BY MICHAEL BROWN

NEST LABS RECENTLY launched two products: its first security camera, a slimmed-down version of the popular Dropcam Pro called the Nest Cam, and a second-generation Nest Protect smoke and carbon-monoxide detector. The company also announced a software update for its Nest Learning Thermostat that adds at least one new feature: notifications when temperatures in the home drop low enough to freeze pipes. And for the first time, consumers who have all three devices in their homes will be able to access each device from a single app.

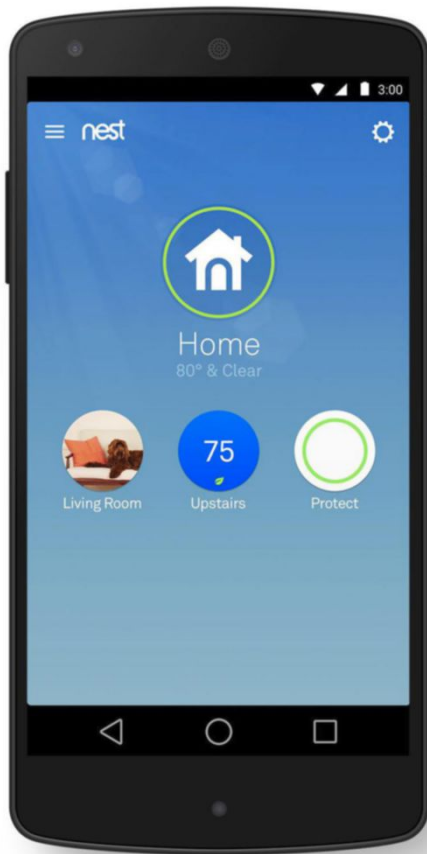
Like the highly rated Dropcam Pro (go.pcworld.com/dcp) it replaces (Nest acquired Dropcam in a \$555 million deal in 2014), the Nest Cam records video at 30 frames per second in 1080p resolution, and it delivers the same wide-angle, 130-degree field of view. Sound and



motion sensors built into the camera will trigger the camera to record clips that are uploaded to the cloud. According to a Nest press release, the Nest Cam provides better night vision than the original thanks to new infrared LEDs and algorithms that can discern the difference between a flashlight and sunlight, so the camera won't become confused and switch to day mode when a bright light passes in front of the camera.

If you have a Nest Protect and a Nest Cam in the same room, a camera button will appear on your phone if you receive a smoke or CO alert. Touch the button and you'll be able to see what's going on in your home. The camera will also record a clip of what triggered the alert, even if you don't subscribe to the new Nest Aware cloud service. This feature will also be available with the older Dropcam and Dropcam Pro cameras.

Buyers who do sign up for Nest Aware (subscriptions cost either \$10 per month for 10 days of storage, or \$30 per month for 30 days) will also benefit from more powerful cloud-based motion analysis; they'll be able to create activity zones within the camera's field of view, so that alerts are generated only when



A new app will
unify control of all
three of Nest
Labs' products.

**While it retains**

the same name as the original Nest Protect, the new model features a number of hardware improvements.

motion is detected in that area (such as a door); and they'll be able to edit, save, and share up to three hours of video clips.

Improved Nest Protect

The new Nest Protect is significantly smaller and features a new sensor that Nest says does a better job of differentiating between dangerous levels of smoke and the harmless smoke that results from, say, overzealous cooking in the kitchen or that wafts in from the barbecue on the patio. And when the detector does report a false alarm, you'll be able to silence it with an app on your smartphone or tablet (the first-generation Nest Protect was recalled because its "wave" feature could prevent the alarm from going off in the event of a real fire). The redesign also includes a new smoke chamber that's designed to address another common complaint about the first-gen product: dust and insect incursions.

Experts say you check the status of your smoke alarm every month to make sure it's in working order, but no one actually remembers to

do so. The new Nest Protect will automatically check itself monthly to ensure it's in working order, testing its speaker and horn and using its built-in microphone to ensure they went off.

You can also manually check the alarm using the app on your smartphone or tablet. For even more peace of mind, a new feature called Whole Home Nightly Promise will trigger every Nest Protect in your home to generate a green glow when you turn out the lights


to report that everything is in working order, or a yellow glow if there's something amiss with any of them. This feature is available in both first- and second-generation Nest Protects.

The new Nest Protect will automatically check itself monthly to ensure it's in working order

What's missing

One feature notably absent from the Nest Cam is facial recognition. The ArcSoft SimpliCam and, more recently, the Netatmo Welcome home-security cameras can both detect human faces and identify who a person is. These cameras will send alerts when an unrecognized person passes in front of the camera, so you're not bombarded with alarming messages about motion detected in your home.

These announcements unify three elements of Nest Labs' connected-home strategy: security cameras, climate control, and fire protection. Like Apple with its HomeKit initiative, however, Nest still has a long way to go when it comes to offering a complete connected-home strategy, one that includes lighting controls, smart door locks, door/window sensors, and other home systems.

Nest won't try to reinvent any of those wheels, relying instead on third-party products that use its Thread low-power network protocol. I'm also waiting to see if the company will do anything with the awesome Revolv smart hub (go.pcworld.com/rev) that it acquired—and promptly killed—in 2014. 

I was one of the **1** in **5**
Children in America who
STRUGGLE WITH HUNGER
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End to childhood hunger.

Viola Davis

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The *Hunger Is* campaign is a collaboration between The Safeway Foundation and the Entertainment Industry Foundation to raise awareness and improve the health of hungry children.

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The Safeway Foundation and the Entertainment Industry Foundation are 501(c)(3) tax-exempt organizations. Photo by: Nigel Parry

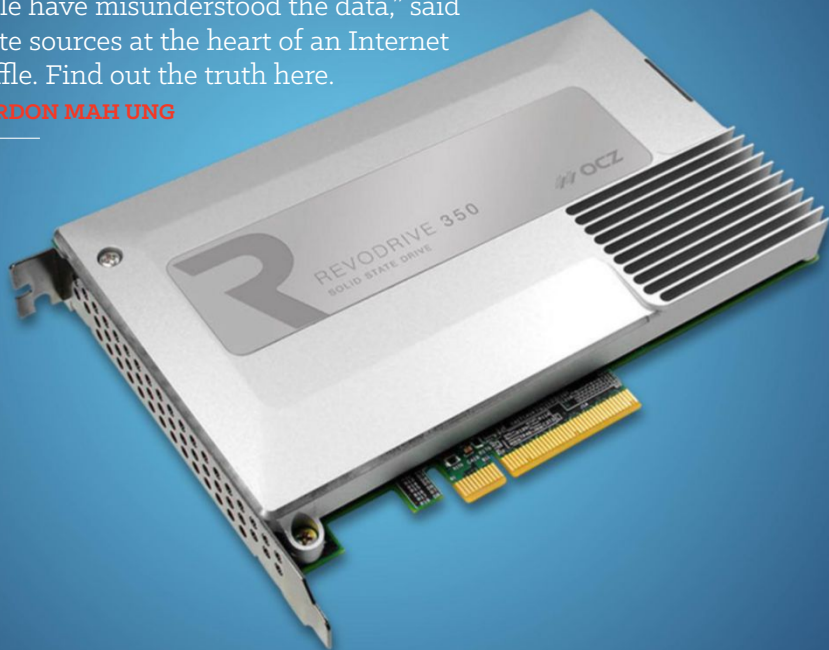
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CONSUMER WATCH

Debunked: Your SSD won't lose data if left unplugged after all

"People have misunderstood the data," said Seagate sources at the heart of an Internet kerfuffle. Find out the truth here.

BY GORDON MAH UNG



IF YOU'RE IN a panic because the Internet told you that your shiny new SSD may lose data in "just a few days" when stored in a hot room, take a chill pill—it's apparently all a huge misunderstanding. In a conversation with Kent Smith of Seagate and Alvin Cox, the Seagate engineer who wrote the presentation that set the Internet abuzz, PCWorld was told we're all just reading it wrong.

Misunderstanding

“People have misunderstood the data,” Smith said. Cox agreed, saying there’s no reason to fret.

“I wouldn’t worry about [losing data],” Cox told PCWorld. “This all pertains to end of life. As a consumer, an SSD product or even a flash product is never going to get to the point where it’s temperature-dependent on retaining the data.”

Why this matters: Users from New York to Rio De Janeiro are freaking out over the risk of losing data when their SSDs are powered off. We decided to go to the source of it all for the truth.

The original presentation dates back to when Cox chaired a committee for JEDEC, the industry group that blesses memory specs. It was intended to help data center and enterprise customers understand what could happen to an SSD—but only *after* it had reached the end of its useful life span and was then stored at abnormal temperatures. It’s not intended to be applied to an SSD in the prime of its life in either an enterprise or a consumer setting.

It looks like a misunderstanding of this 5-year-old PowerPoint page set the Internet ablaze.

JEDEC Global Standards for the Microelectronics Industry

Temperatures and data retention

- Tables show # weeks retention as a function of active and power-off temperatures.
- Numbers are based on Intel's published acceleration model for the detrapping retention mechanism (the official JEDEC model in JESD47 and JEPI 22 for this mechanism).

Client

Power Off Temperature	55	1	1	2	2	3	5	8
55	2	2	3	4	6	9	15	
45	4	4	5	7	10	17	25	
40	7	8	10	14	20	31	52	
35	14	16	20	26	38	61	101	
30	28	32	39	55	76	120	199	
25	55	65	79	105	155	244	404	
	25	30	35	40	45	50	55	

Active temp.

Enterprise

Power Off Temperature	55	0	0	0	0	1	1	2
55	0	0	0	1	1	2	4	
45	0	1	1	1	2	4	7	
40	1	1	2	3	4	7	13	
35	2	2	3	5	8	14	25	
30	3	4	6	10	16	28	50	
25	7	9	12	20	33	58	101	
	25	30	35	40	45	50	55	

Active temp.

Material submitted by Intel

But that's not how the Internet viewed it. The presentation—almost five years old now—surfaced in a forensic computing blog (go.pcworld.com/fcblog) as an explanation for why an SSD could start to lose data in a short amount of time at high temperatures. Once media outlets jumped on the story, it spread across the globe.

“The standards body for the microelectronics industry has found that Solid State Drives (SSDs) can start to lose their data and become corrupted if they are left without power for as little as a week,” said the *International Business Times* (go.pcworld.com/ibt), one of the first to run a story on the blog post. From there, the Internet seemed to amplify as fact that an SSD left unplugged would lose data—all citing Cox's JEDEC presentation.

But Cox and Smith said that's not correct. In fact, both said, an SSD that isn't worn out rarely experiences data errors. Data center use also subjects SSDs to far more “program/erase” cycles than a typical consumer could under any normal circumstances.

Cox and Smith cited numerous tech websites that have torture-tested SSDs well beyond their rated life spans using 24/7 work loads. *The TechReport* (go.pcworld.com/techreport) did manage to kill a number of SSDs, but only after writing hundreds of terabytes to them. Some of the drives still made it beyond the petabyte range.

Wear is one of the risk factors for SSD data loss at high temperatures, but because it's nearly impossible for an average user to wear out an SSD, the danger is very small, Cox and Smith said. Even a worn-out SSD would still go a year without data loss, according to the original presentation, and that's while being stored at 87 degrees Fahrenheit the entire time.

For the same reasons, Smith said, enterprise customers are also




Consumer drives have been pushed beyond 1.1 petabytes of writes before wearing out. That's one of the criteria you'd need to lose data.

unlikely to suffer from heat-related dead drive issues. Besides, they're more likely to use tape or other cheaper methods to back up data.

That's not to say that SSDs aren't immune from failures and data loss. Like all electronics, there's always the risk of failure.

"I wouldn't worry about (losing data)."—Alvin Cox

Our own story (go.pcworld.com/pcwssd) helps put SSD failure rates in perspective.

Smith and Cox said the intent of the original presentation was to illustrate a worst-case scenario. What if the truck with the SSDs from the data center broke down, in the Arizona desert in July, on the way to the archiving center? How long could the truck be parked before data loss occurred from excessive heat? While that's a scenario that could happen, it's also highly unlikely—which is why the fear gripping SSD owners is unwarranted. 



‘Your PC may be infected!’ Inside the shady world of antivirus telemarketing

BY JEREMY KIRK

SCOTTY ZIFKA WAS looking for a sales job. He started one in late May at a company called EZ Tech Support, a small inbound call center in an older building in northeast Portland, Oregon.

The first day of Zifka’s unpaid training involved listening in on sales calls. But within three hours, Zifka felt something wasn’t quite right.

“Everything about it was so weird,” he recalled.

The company's 15 agents answer calls from people who've seen a pop-up message saying their computer may be having problems, and advising them to call a number, which rings at the offices of EZ Tech Support (eztech.support).

The agents are instructed to stick to a 13-page script. They ask callers whether they have an antivirus program installed. If they do, Zifka said, callers are usually told that whatever they're using isn't a "full-time real spectrum virus protection program."

But the agents have a solution: callers can purchase an antivirus program called Defender Pro Antivirus, from Bling Software.

EZ Tech Support sells a perpetual license for the program for \$300. Agents also tell callers they can perform a one-time fix on their computers for them, which starts at \$250. Callers can haggle for lower prices.

Those dialling in are typically in their late 30s or older. "A lot of mothers would call in and say, 'I'm sure it's something my son did on my computer. This has happened before,'" Zifka said. "Older gentlemen—seniors specifically—that was the most unfortunate part."

Within 20 minutes, some callers spent up to \$600 to "fix" their computers. "I was blown away by this," he said.

EZ Tech Support's general manager, Gavynn Wells, said the company abides by U.S. Federal Trade Commission regulations.

"We don't tell customers that they have issues they don't have,"

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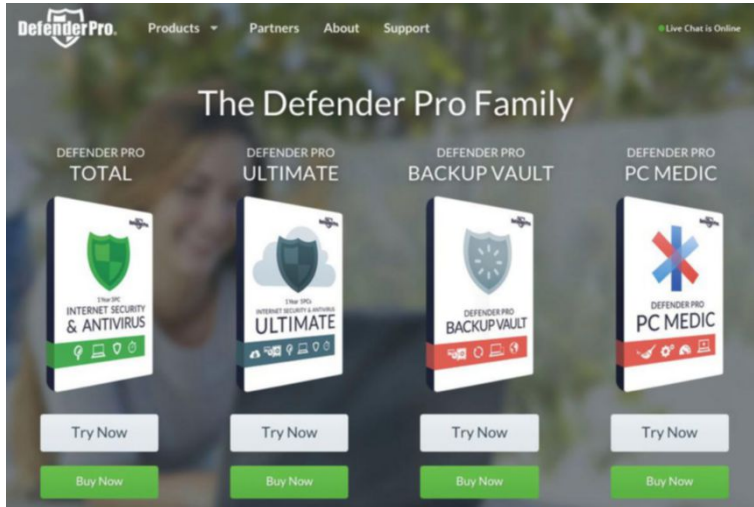
REFUND POLICY
Our products and services are 100% guaranteed and so is your satisfaction. If we can't make it right, we will gladly issue a 100% refund.
[Read more](#)

Agents at EZ Tech Support had a job to do: upsell hapless consumers who thought they had a computer virus.

Wells said in phone interview. “We are not pushing them into a corner and telling them if they don’t do business with us, their computer is going to blow up.”

A \$4.9 billion industry

Consumer antivirus software has become a highly competitive business, in part because data breaches are in the news almost every week, and people feel a need to protect themselves. It’s also a huge market, with an estimated \$4.9 billion in annual sales, according to Gartner.



Defender Pro

Antivirus is effective at detecting malware, but an independent testing company says it is buggy.

That’s drawn all types of players, some of whom specialize more in affiliate marketing than in security.

Tech support services abound on the Internet, and phone numbers for some of those businesses are often found in bundles of questionable software known as adware. People willingly download adware, often to get a free program, but it can also be foisted on them through vulnerabilities in their software.

Some adware programs display messages to people suggesting

their computer is at risk, even though the adware programs aren't designed to detect security problems.

Lawrence Abrams, who runs the popular Bleeping Computer (bleepingcomputer.com) security forum, said people have complained about pop-up windows in their browsers that they can't close. In some recent cases, a man or a woman's voice tells them their computer has become infected.

"You just cannot shut the program down," said Abrams, who deliberately downloads harmful programs for his research. "So people panic, and they call the number."

Those most vulnerable are people who know little about computers and find the warnings intimidating, he said.

The FTC has started to go after some of the biggest U.S.-based tech support companies that take this type of inbound call. In November, it filed two complaints (go.pcworld.com/ftc2) alleging tens of thousands of consumers had been conned out of more than \$120 million by companies using high-pressure, deceptive sales tactics to sell software and support services.

Wells, of EZ Tech Support, used to work for one of the companies targeted by the FTC, Inbound Call Experts, before moving to Portland last year.

Although a federal judge shut down Inbound Call Experts shortly after the lawsuit was filed, the company was allowed to resume business after it agreed to changes in how it markets its services. The case, however, continues, and court records show that Inbound Call Experts and the FTC have agreed on a mediator to discuss a settlement.

The poor perception of companies offering remote support services has made it harder for legitimate ones to operate, said Dan Steiner, CEO of Online Virus Repair (onlinevirusrepair.com), based in San Luis Obispo, California. "It's definitely not a positive image," said Steiner, who added that not many companies offered remote computer

The poor perception of companies offering remote support has made it harder for the legitimate ones.



support when he started his business back in 2008.

But the industry exploded, with many companies opening call centers outside the United States. For legitimate companies, marketing their services online proved near impossible amid the high volume of unethical businesses.

Steiner now focuses on word-of-mouth advertising, and partnerships with those he trusts in the anti-malware industry.

Worth the money?

Several years ago, it wasn't uncommon for adware-promoted security products to be classified as malicious software. But tactics have changed, and unscrupulous companies now sometimes sell functional products but greatly overcharge for them.

It's a tough situation for regulators: the FTC can't protect people from companies that stay within the law while marketing what may not be the world's greatest product.

The product EZ Tech Support sells, Defender Pro, appears to be

EZ Tech

Support's office
is in this Portland,
Oregon, building.

legitimate antivirus software, said Andreas Marx, CEO of AV-Test (av-test.org), an independent organization in Germany that tests consumer antivirus suites.

The product uses a well-known antivirus engine licensed by a reputable company called Cyren (cyren.com). Marx said his analysts tested a trial version downloaded from Defender's Pro website. It was effective at detecting malware but also "really buggy," he said via email. "After an update, for example, it repeatedly crashed," he said.

The retailer Target at one time sold Defender Pro in its stores. A spokesman declined to say why it is no longer stocked. Target's website still has an old product page for Defender Pro 2012, which sold for \$19.99.

Marx said \$300 is too much for Defender Pro, given that there are similar, basic antivirus scanners available for free from companies such as Avira, Avast, and AVG. Products with Defender Pro's feature set should cost no more than \$30 per year, he said.

By that measure, a user would need to keep the same computer for 10 years to justify EZ Tech Support's pricing for Defender Pro.

Agents call out anything flagged by the scan, even if it's not a security risk.

Closing the sale

Zifka, who quickly left the company, said EZ Tech Support agents install a remote control tool called LogMeIn Rescue to get access to callers' computers with their permission. They then install Webroot's Analyzer program (go.pcworld.com/analyzer), a legitimate tool that flags issues on a computer.

But Zifka said agents call out anything flagged by the software, even if it's not a security risk for the user. "We used whatever it states as a selling point," Zifka said.

In lawsuits, the FTC has accused telemarketing companies of installing a remote tool and then using other programs, such as the Windows Event Viewer, to illustrate errors and warnings that actually

have no material effect on a computer.

Wells disputes Zifka's characterization and maintained that callers aren't informed of problems that don't exist. If a caller says he is already using AVG's free antivirus product, Wells said agents will say they have good protection against viruses "but they could benefit from having something that protects them against malware."

When it was pointed out that AVG's product does protect against malware, Wells said: "Well, I was just using that as an example."

Although EZ Tech Support is registered (go.pcworld.com/wells) in Wells' name with Oregon's Secretary of State, he said the business is owned by an investment company which he declined to name.

Wells said he's also not involved in the adware campaigns that distribute the phone numbers that ring to EZ Tech Support. But he said the company will remove the adware for people who call.

"We really pride ourselves in doing a good job for our customers," he said. 🔌



AT&T faces \$100 million fine for misleading consumers

BY MARTYN WILLIAMS

THE FEDERAL COMMUNICATIONS Commission plans to fine AT&T \$100 million for misleading customers by throttling speeds on the lines of millions of customers who had “unlimited” data plans.

The FCC alleges (go.pcworld.com/violation) that AT&T did not adequately disclose to its customers on 4G “unlimited” data plans that

their speed would slow drastically after they had reached a monthly data allowance of 5GBs. The policy began in 2011.

Data speeds were significantly slowed to 512kbps from the advertised 5Mbps to 12Mbps under something AT&T called its maximum bit rate policy. That very name is clearly at odds with an unlimited plan, a senior FCC official told reporters on a conference call.

By not clearly informing consumers of this policy, AT&T was in violation of the Open Internet Transparency Rule of 2010, which requires that Internet providers offer clear and accurate information to consumers so they can make informed choices on Internet service, the FCC said.

The fine is the largest proposed by the FCC in its history, but it's not a done deal yet. AT&T has 30 days to respond in writing to the FCC's charges, after which the commission will adjudicate the complaint and determine a final fine.

The FCC said it's aware that the fine, while large, is a fraction of the revenue AT&T made from offering its unlimited plan to consumers. It is also considering other redress, including requiring AT&T to individually inform customers that its disclosures were in violation of rules and to allow them out of applicable contracts with no penalty.

AT&T said it plans to vigorously dispute the FCC's assertions.

"We have been fully transparent with our customers, providing notice in multiple ways and going well beyond the FCC's disclosure requirements," it said in a statement.

An AT&T spokesman pointed to previous FCC guidance on disclosure of network management policies that noted providers must, at a



The FCC said it's aware that the fine is a fraction of the revenue AT&T made from offering its unlimited plan to consumers.

minimum, provide a “publicly available, easily accessible website” and that “broadband providers may be able to satisfy the transparency rule through a single disclosure.”

AT&T had demonstrated this through notifications on billing statements, text messages sent before throttling, detailed information about the process on its website and in the language on its customer agreement, he said.

Nonetheless, the carrier recently changed the way it throttles data throughput for customers with 4G unlimited data plans. In the past it would automatically slow speed when the 5GB limit was reached, but in May it said it “may” slow speeds after 5GB in accordance with network management requirements. 🔌

Amazon expands free same-day Prime delivery in the U.S.

BY IAN PAUL



AMAZON IS DRAMATICALLY expanding its same-day delivery service to cover millions of Americans. Called Prime Free Same-Day, the beefed-up offering is now available in 14 of the country's major metropolitan areas. The service covers more than one million items in Amazon's store to let you get that GoPro camera or Amazon Kindle before bedtime.

Amazon is also unifying its same-day delivery policies by applying the same rules across the country. If you order by noon in an eligible area, you'll get your items by 9 PM. Order between noon and midnight, and your order arrives the next day.

Check out the company's dedicated webpage (go.pcworld.com/)



Amazon Prime is offering same-day delivery in 14 metropolitan areas.

[sameday](#)) for a complete list of Amazon same-day delivery areas. You can also search by zip code to see if your home is covered by the new service.

Prime Free Same-Day isn't exactly free, however. You only get free same-day shipping if your order is \$35 or more, and you're an Amazon Prime member. Under \$35, Prime members will pay \$5.99 for same-day delivery, and non-members will pay \$8.99 plus another 99 cents per item.

The story behind the story

Expanding same-day delivery is yet another perk to encourage more people to sign up for Amazon Prime memberships. More members translates into more loyal customers for Amazon, which is important as Walmart reportedly gears up to compete with Prime.

Same-day shipping has also been something of a slow-moving experiment for online retailers. Amazon began its effort in 2009, followed by Walmart in 2012, and then Google in 2013. Tech retailer Newegg got into same-day delivery last August, and Apple is experimenting with same-day delivery in select areas. Amazon's latest expansion puts the company in front of its online competitors.

Not your business

Amazon's new service appears to be focused largely on home deliveries, as the company warns that commercial addresses may not be eligible for same-day delivery. The online retailer also won't deliver same-day items on major holidays, including Thanksgiving Day, Christmas Day, and New Year's Day. Amazon says same-day delivery will be limited on other unspecified holidays and "high-volume shopping days"—sounds like Black Friday same-day is out. 🔌

Amazon hopes to use drones to deliver packages in the United States this year.



You might know **Joshua**.
He loves video games, and he
owns enough to know they're not
all meant for kids. That's why he
reminds his friends (at least the
ones that have kids) that they all
have **big black letters on the box**
to help parents find the ones that
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REVIEWS & RATINGS

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TESTED IN PCWORLD LABS

In this section, hardware & software go through rigorous testing.

REVIEWS & RATINGS



CyberPower Trinity Xtreme PC looks insane but is surprisingly upgradeable

Yes: It's a PC and more amazingly, it's just off-the-shelf parts.

BY GORDAN MAH UNG

YOU KNOW HOW YOUR sandal-wearing, tablet-toting partner insists on organically grown, free-range, gluten-free water? Gamers are the same way about their rigs and their need for industry-standard parts. Proprietary? Might as well be a genetically modified flesh-eating tomato.

Sure, proprietary gets you designs such as Apple's Mac Pro, but you're left high and dry when it's time to upgrade.

That won't happen with CyberPower's new Trinity Xtreme (go.pcworld.com/trinityxtreme), which gives you a truly exotic look without the penalties.

What's inside

CyberPower sells several different versions of the Trinity. Its Trinity 100 runs on AMD APUs and rings in around the \$1,000 mark. The Trinity 200 is the midrange part with Intel's Haswell quad-core inside, while the unit here is dubbed the Trinity Xtreme. Like the Falcon Northwest Tiki (go.pcworld.com/falconnw), it uses Asrock's X99 E-ITX/AC motherboard, which lets CyberPower shoehorn a six-core



Watch the
video at
[go.pcworld.com/
trinity100vid](http://go.pcworld.com/trinity100vid)



The magic of the Trinity Xtreme is its use of off-the-shelf components.

Core i7-5820K CPU inside. There are eight-core options, but the Core i7-5820K lets CyberPower put more cash toward the GPU. In our case, it's a GeForce GTX Titan X. You could argue that a GeForce GTX 980 Ti makes more fiscal sense now, but the Trinity Xtreme arrived right before the 980 Ti was released.

For storage there's a 2TB hard drive and a 250 GB Samsung 850 EVO SSD. It's all powered by an 850-watt Corsair CS-series PSU.

Remember, these are all off-the-shelf parts. What you're probably wondering is how it all fits in there.

Each of the pods, or "blades," as CyberPower calls them, store different components. The right pod holds the Mini ITX motherboard, CPU and radiator. The left unit holds the PSU and has enough space for two 3.5-inch hard drives. The top pod holds a standard GPU. In our case, again, it's a standard GeForce Titan X inside and it definitely looks



A Titan X powers the gaming capability of the CyberPower Trinity Xtreme. It looks like you could fit a dual-GPU card in there, too.

like there's room for a dual-GPU card such as a Titan Z or an older GeForce GTX 690 card. Sorry Radeon R9 295X2, there's no place to put your radiator, but maybe give me a call when the fabled dual next-gen card shows up in this time line.

For expansion, there's room in the Trinity Xtreme for another two 2.5-inch drives and another 3.5-inch drive. Believe it or not, there's actually room for a slimline optical drive between the two 3.5-inch drives. Our unit didn't come with it though. Perhaps CyberPower figured you couldn't play your fantasy of being a James Bond supervillain while burning a CD.

CyberPower PC CyberPower Trinity Xtreme

PROS:

- Crazy looking
- Certified James Bond Super Villain Computer
- Takes up a lot of desk space

CONS:

- Heavy

\$2,770

How it all works

You're probably wondering how exactly it works. The case used—DeepCool's TriSteller—delivers a clever sleight of hand. All three hefty pods connect through a steel center shaft that has cutouts to run the PSU and SATA cables, as well as the folded PCIe cable for the GPU.

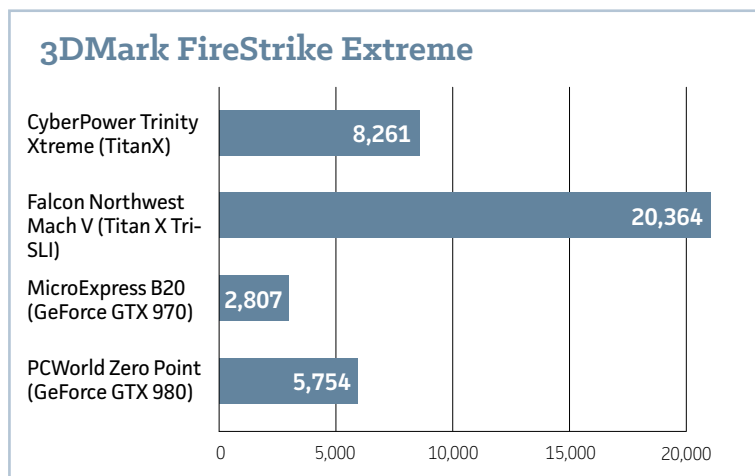
DeepCool's TriSteller is available to DIYers who want to build their own, but right now I'm not seeing it in the United States. The only seller I could find was Amazon in the United Kingdom, and only if you're willing to pony up \$750 for this "hand made PC case" that's also a limited-edition item, according to DeepCool.

That's a steep price for the TriSteller case. That with Titan X helps push the price of the Trinity Xtreme to \$2,700. That's above CyberPower's typically super-affordable prices and has me wondering how it can even afford to sell the PCs.

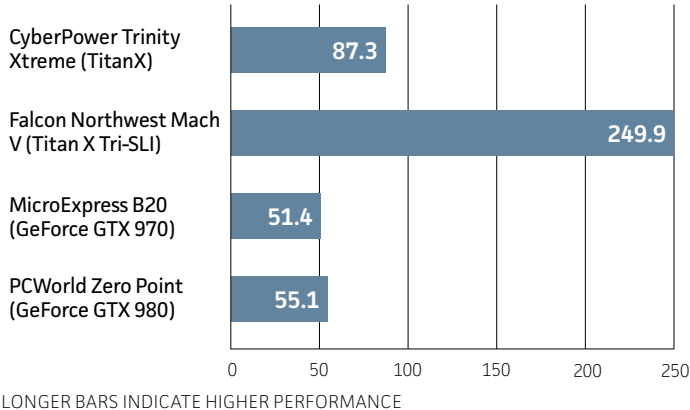
Performance

As cool as the Trinity Xtreme looks, it wouldn't matter if it couldn't perform. The good news is a single Titan X and six-core Haswell-E chip performs where you'd expect. I compared the Trinity Xtreme with the MicroExpress MicroFlex B20 (go.pcworld.com/micro), our quad-core

The single GeForce Titan X in the Trinity Xtreme offers near-4K gaming capability.



TombRaider Ultimate (25x16)



The Trinity

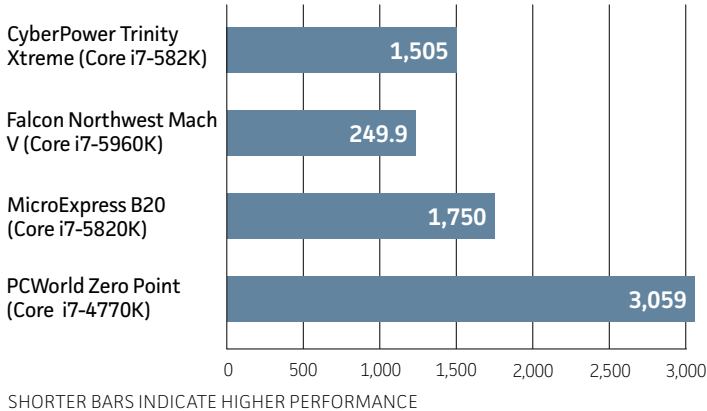
Xtreme should offer well above 60 fps in any gaming task on a 2560 x 1600 resolution monitor, or roughly half the pixels of a 4K monitor.

Core i7-4770K and GeForce GTX980 reference system and the Falcon Northwest Mach V (go.pcworld.com/machv) with its three-Titan X cards. The Mach V is there mainly for reference so you can see what two more Titan X cards (and three times the price) buys you.

If you're concerned with the shorter bar, don't be. For a practical game, such as Tomb Raider set to Ultimate quality and playing on a 30-inch, 2560 x 1600 resolution monitor, the Trinity Xtreme will have you moving along at almost 90 fps. You should be fine at 4K resolution too, but I'd recommend coupling a single Titan X with a G-Sync monitor (go.pcworld.com/g-sync) to help compensate for the occasional frame-rate dips.

It's not all about the GPU though, so I also compared all four systems in our hefty Handbrake encode test, where we transcode a 30GB file to format for Android tablets. The six-core setup shows why it's the best bang for buck for those who do a lot of multithreaded tasks. I still have some questions about the impact of the bandwidth limitation on the Trinity Xtreme. Like the Falcon Northwest Tiki, the Asrock board used here gets the six-core CPU into a small frame by compromising on system RAM bandwidth. It's essentially only two channels instead of the available four channels, but it doesn't appear to hurt much that I can see.

Handbrake Encode 0.9.9 (sec)



The six-core

Core i7-5820K in the Trinity Xtreme offers slightly more performance than other six-core chips we've seen and easily outruns the quad-core in our PCWorld reference machine.

Why? Just why?

The real question with the Trinity Xtreme is whether it's worth the bulk and the weight. The same system built into a standard micro-tower PC would save you a lot of desk space—and frankly, given the cost of the TriSteller case, a lot of cash.

That's a question only you can answer. Maybe you're just tired after years and years of PCs that stole their design plans from a cereal box. You just want something that looks truly unique.

Maybe you really want to show up your friend who likes to talk about how cool their gaming rig is. Or maybe, just maybe, you just want to think different but don't want to pay the penalty when it's time to upgrade down the road. 🔌



The Lenovo LaVie Z is crazy-light and surprisingly fast

BY GORDON MAH UNG

OUNCES COUNT IN CAVIAR, precious metals, and the laptop that's carving a divot into your shoulder while you're standing in line for the plane.

It's these folks Lenovo is hoping to snag with its new LaVie Z (go.pcworld.com/lenovo-laviez), which claims the title of being the lightest 13-inch laptop in the world.

I can confirm after receiving our unit for testing that yes, the LaVie Z is so incredibly light, at 1.94 pounds, you'll initially wonder if it has any components in it at all. Hell, I wondered if Lenovo had shipped us one

of those fake display laptops they use at the furniture stores.

But Nerd's Honor, this is a fully functional machine. Even more surprisingly, it's fast—though you'd expect nothing less with a Core i7-5500U, 8GB of LPDDR3, and a 256GB Samsung M.2 SATA SSD inside.

Lighter than air (Apple's, too)

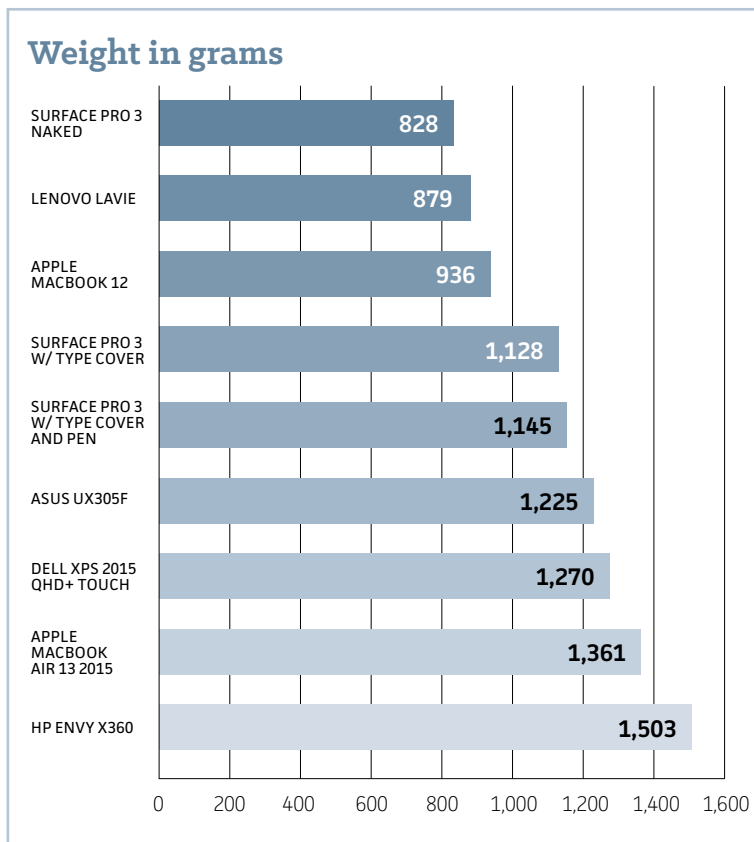
The LaVie's claim to fame is its weight. To achieve it, Lenovo (and NEC, which manufactured the unit through its joint partnership with Lenovo) made a lot of choices to shed ounces. The first is the shell, which Lenovo says is magnesium lithium. To keep it even lighter, the top deck is a single extruded piece rather than a two-piece assembly.

Batteries also contribute a lot to laptop weight, so Lenovo opted for a high-resolution IGZO panel. IGZO (indium gallium zinc oxide) increases efficiency in how light is passed through the LCD display at high resolutions, and also in power leakage. Because the display doesn't have to be driven as hard to attain the same brightness as other high-resolution panels, Lenovo was able to use a smaller battery for the LaVie Z than it would have needed with a typical IPS display.

Lenovo's new LaVie enters the 13-inch club (center) which includes HP's Envy X360 (left front) Asus' UX305 (right front) Apple's Mac Book Air 13 2015 (rear left) and Dell's XPS 13 2015 with QHD+ touch screen.



The Lenovo LaVie Z is truly an amazingly light laptop.



Rather than rely on manufacturer specs, I weighed each of the computers above on our obsessive-compulsive Pitney Bowes postage machine, in grams. All machines were weighed sans charger brick. Because I know the Surface Pro 3 mafia would chime in if I ignored it, I threw in the Surface Pro 3 with Type Cover and Surface Pen. I weighed the Surface 3 Pro without the cover and pen, too—which, frankly, makes it kinda useless.

As you can see the LaVie Z is beaten only by the naked Surface Pro 3. Even Apple's smaller MacBook 12 is heavier than the LaVie Z. When you consider that the LaVie Z packs a bigger, higher-resolution screen



than the MacBook 12, that makes Lenovo's feat even more impressive.

It's also worth noting that some of the units are at a disadvantage here. The Dell XPS 13 without touchscreen sheds some weight, but it still can't touch the LaVie Z.

Build Quality

As mentioned before, the LaVie Z is actually an NEC laptop and thus has a different look and feel than most Lenovo laptops I've touched. This is no ThinkPad. The lithium magnesium shell that helps save weight has quite a bit of give to it, for instance. I won't say it feels flimsy, but pick up the HP Spectre x360 (go.pcworld.com/hpspectre-x360), Dell XPS 13 (go.pcworld.com/dellxps) or Apple MacBook 12—all feel solid, with no shell flex. The LaVie feels almost hollow when squeezed between your fingers.

The good news is, structural integrity doesn't seem to take a hit. I was able to do the classic "hold it by the corner" without feeling like the LaVie Z was going to fold up like an empty can of Budweiser. You can't do that on all laptops. On the original Google Chromebook Pixel, for example, the corner test would render the trackpad inoperable occasionally due to body flex. The LaVie Z is obviously helped because it's just so damned light.

It's how you use it, right? The one-inch difference between the LaVie and MacBook 12 looks sizable here and makes it even more amazing that the LaVie is lighter.

Audio quality? There is none.

If you're the cynical nerd who likes to scoff at the ridiculous claims of "audio by Harman / Beats / B&O" stickers on laptops, you'll be happy to find there is no such certification here.

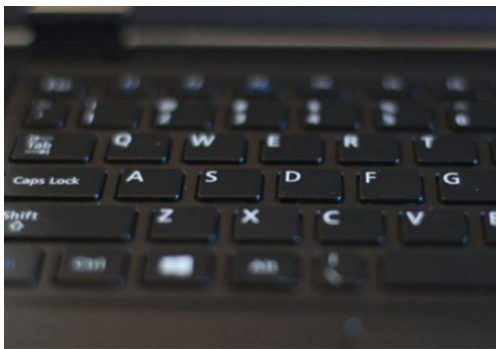
Unfortunately that's probably because no audio company would actually associate its brand with the LaVie Z's poor audio. Yes, it's that atrocious. Ultrabook audio tends to go from poor to awful. A few standouts include Dell's current XPS 13 and HP's Spectre x360. Both are adequately loud, and the Spectre x360 has better midrange and low-end bass.

The LaVie Z's audio is so bad it's hard to believe. I'm sure if I cracked the LaVie Z open, the world's smallest and lightest kazoo player would wave back at me from inside.

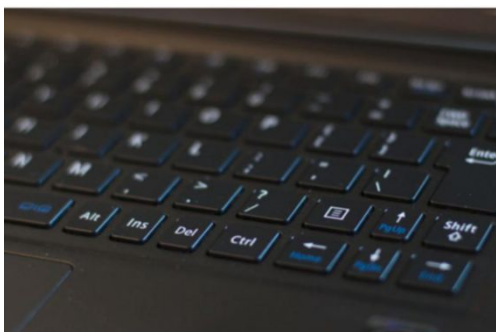
Keyboard and trackpad

While I found the trackpad with its slightly textured surface to be fine, I won't say the same of the keyboard. I tried the early LaVie Z at CES and complained the keyboard wasn't "Lenovo enough." Unfortunately, not much has changed. The keyboard is smaller, and the keys tiny. It's even smaller than the keyboard in the Dell XPS 13 2015, which I think is right on the edge of usability.

I've been using an XPS 13 long enough to say it's almost a deal-breaking feature on an otherwise spectacular laptop. I'll say the same for the LaVie Z, but in this case it's probably going to be a deal-breaker for some. You'll really need to try the keyboard first to see if



The keyboard is smaller than the other laptop's I've seen and borders on unusable.



The LaVie Z makes some odd keyboard decisions.

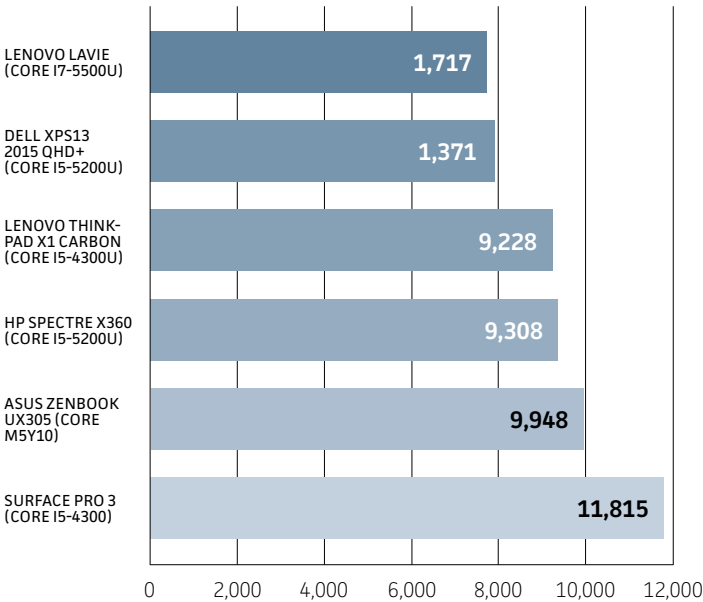
you can live with it. I'm also not a fan of the keyboard layout, such as the function key in the lower left. That's where the Ctrl key goes, Lenovo! Yet other wacky keyboard decisions will require further acclimation.

The screen is meh, too

The LaVie Z's display looks better on paper than to the naked eye. Its resolution of 2560 x 1440 amounts to 3.7 million pixels—right between the 2 million pixels in the 1920 x 1080 panel in the HP Spectre x360 and the 5.7 million in the Dell XPS 13 2015. When I measured the brightness, however, it maxed out at 235 nits—which just isn't bright. The XPS 13 2015, for example, hits 400 nits. This could be another conscious decision by Lenovo/NEC to control power

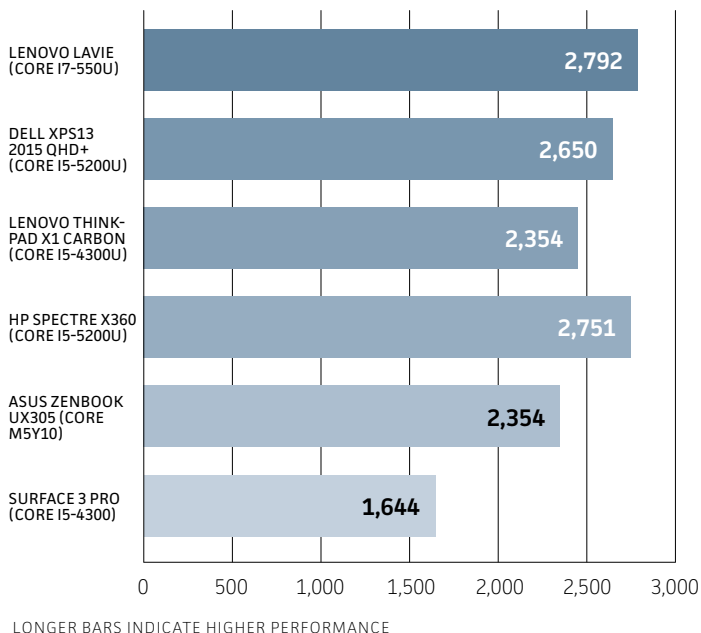
The LaVie Z's Core i7 higher clock pays off as it's faster than all other Ultrabooks we've seen to date, despite its zany light weight.

Handbrake 0.9.9 (sec)



SHORTER BARS INDICATE HIGHER PERFORMANCE

3DMark Skydriver



Core i7's performance in gaming tasks again beats the much heavier competition although the Spectre x360 comes close (until it heats up that is.)

consumption, but it's disappointing regardless.

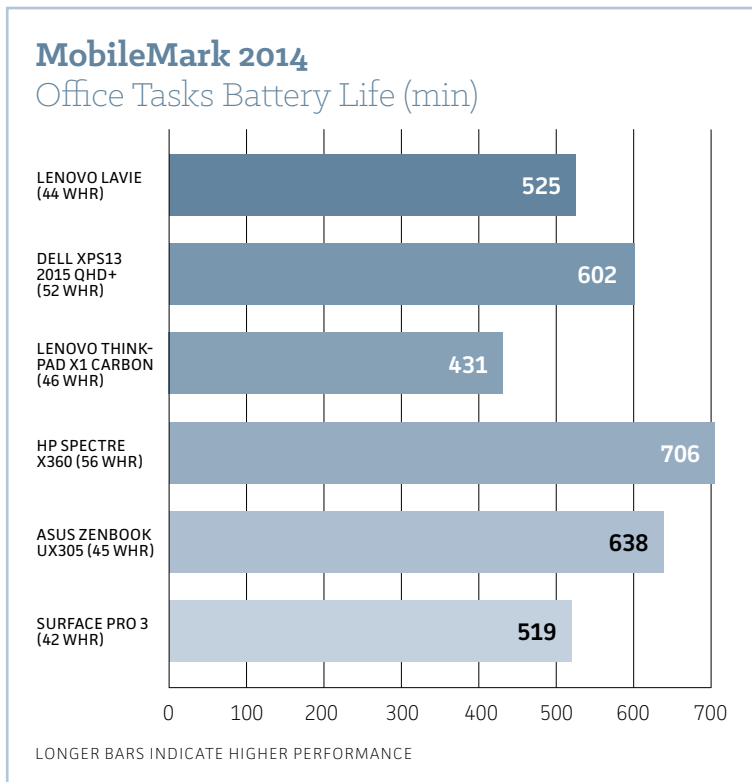
The display quality varied. I didn't see excessive bleeding from the backlighting, and compression banding was kept to a minimum. Backlighting evenness was mediocre, but that's with the white background on maximum brightness and in a darkened room—you'd be hard pressed to see it under "normal" conditions. I still judge the panels in the Dell XPS13 2015 and HP Spectre X360 to be better here.

Viewing high-resolution images, I'd say the panel in the LaVie Z I have is under-saturated compared to the competitors. That may be a result of the anti-glare coating, but I also found the off-axis viewing to be inferior to that of the competition.

Performance is great

The good news? Performance is pretty awesome for something this light. I'll start this off with our grueling Handbrake test that takes a 30GB, 1080p MKV file and transcodes it using Handbrake. This not only shows how well the CPUs in the laptops perform, but also shows you what happens to performance under a heavy, long workload. You'll see the same result from something that pushes the GPU for long periods of time.

The Core i7-5500U in the LaVie Z turned in top performance and didn't appear to suffer thermal throttling during our two-hour plus job. The chip is rated only slightly faster than the CPU in the next-best Dell



The LaVie Z gives up decent battery life when you consider its weight and screen resolution.

XPS 13 2015, and this performance is pretty much in line with that.

Throttling matters

You may not think thermal throttling is an issue, and in some ways it isn't, because, you will feel it. You're ostensibly upsold on "faster" laptops based on the pricier Intel chips inside. If your Core i5 is throttling you all the way down to Core i3 performance, what did your money get you? For example: The CPU in the Surface Pro 3 is the same as the ThinkPad X1 Carbon 2014, yet its performance dive due to thermal throttling, as seen in the 3DMark Skydriver results, is significant. Despite being incredibly light, however, the LaVie Z doesn't give up much in performance.

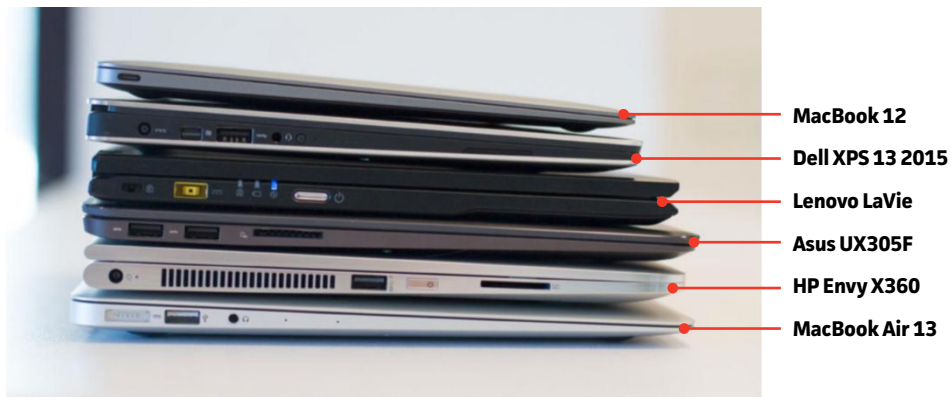


Despite being incredibly light, however, the LaVie Z doesn't give up much in performance.

Fair battery life

The most important performance chart for many will be battery life. I used BAPCo's MobileMark 2014 to measure how long the laptop will run under typical office drone tasks. By that I mean Office, Acrobat, and other All Work and No Play tasks. MobileMark 2014 tends to give you a best-case scenario in battery life for Office Drone work. It even lets off the laptop screen for a few minutes to represent a break you might take during use.

If you think about a laptop, the watt-hour rating is analogous to the gas tank in a car. As noted earlier, Lenovo/NEC opted to keep the battery size small to save weight. It's a 44-watt-hour cell that's about the size of the one in the Zenbook UX305 and the Surface Pro 3. Overall it achieved a fair run time considering the LaVie Z's weight and resolution. It's about on a par with the Surface Pro 3, which has a



To see how the LaVie Z stacks up in ports, we, um, stacked up some leading laptops so you could see at a glance.

lower-resolution panel—but also a power-eating touchscreen. The Zenbook's advantage in battery life is likely due to the Intel Core M and its lower-resolution 1920 x 1080 screen. It's basically serviceable battery life.

Lighter, but thicker too

To give you an idea of the LaVie Z's thinness and port complements, we stacked it against a gaggle of other laptops. In port selection, it's

fair, with two USB 3.0 ports, an HDMI 1.4, and an SD card reader. One thing I'm not a fan of is the power switch, which is oddly placed on the left side of the unit. That's normal on a convertible laptop like HP's Spectre x360, but why do this on the LaVie Z, where the screen doesn't even rotate like that?

The Cost


The last salient point about the LaVie Z is its cost. Spec'd out with the Core i7-5500U, 8GB of LPDDR3 and 256GB Samsung SATA SSD, it pushes \$1,500. That's a slight premium over its contemporaries, but much of that comes from the pricier Core i7 CPU. It's true there's no touchscreen, but there's also a price premium to be considered for the weight. Overall, the pricing is in line with comparable units that play to niche needs.

Lenovo's aim with the LaVie Z was to make one crazy-light laptop. In that regard, I can say the company accomplished its goal.

Conclusion

Lenovo's aim with the LaVie Z was to make one crazy-light laptop. In that regard, I can say the company accomplished its goal. You can chuck the LaVie Z in your bag and you won't know it's there. You may not think there's a world of difference between the almost 900-gram weight of the LaVie Z and almost 1,300 grams of, say, the Dell XPS 13, but when you're carrying it, it matters.

The question is, are the compromises made worth it? The keyboard is almost a deal-breaker. I've used far worse, but those were on tiny netbooks or folding-tablet keyboards. Considering the size and cost of this laptop, Lenovo really should have put a bigger keyboard in the unit when it made the hop across the ocean. The audio is also truly atrocious.

In the comfort of my cubicle, yeah, it bugs me. But the next time I'm been standing in line at the airport for an hour, maybe, just maybe, the trade-off is worth it. 



Samsung GearVR (Note 4 edition) review: Virtual reality gets a great demo kit

BY HAYDEN DINGMAN

I'LL ADMIT: When Samsung first announced it was creating its own virtual reality headset, I rolled my eyes. “Oh great, another me-too product from Samsung,” I thought, envisioning a future where people’s first taste of virtual reality came from some half-baked piece of

garbage Samsung pushed out the door to capitalize on the VR craze.

The irony? I now use Samsung's GearVR (go.pcworld.com/gearvr) almost exclusively to introduce someone to the world of virtual reality. It's perfect for that purpose, even if it lacks the specs and depth to be a true enthusiast device.

Untethered from reality

GearVR is the best thing to happen to virtual reality so far, but not—I think—for the reasons Samsung intended.

See, Samsung is selling GearVR as a consumer device. If you have a Note 4 (or an S6) you can buy a GearVR right this moment. Officially. That's more than can be said about either the Oculus Rift or Valve/HTC's Vive.

But you shouldn't buy GearVR, probably. It's not a great consumer device. We've only had our GearVR review unit for a few months and it's already been outclassed by the new S6 version. Mobile and virtual reality developments are so rapid, your brand-new GearVR is bound to be outmoded in a year at most—and there's no guarantee new apps



will continue to support old GearVR hardware.

Speaking of apps, developers haven't exactly rallied to the GearVR's store the way they've rallied to Oculus Share (the DK1/DK2's official app portal). Despite the fact you can sell GearVR apps, there are still (as of this writing) merely 39 games, 11 apps, and 13 "experiences" in the entire store—many of them made by Samsung itself. Contrast that with Oculus Share's 500 or so DK2-compatible demos, most of which are free and far more extensive.

Suffice it to say, I don't use GearVR much at home. I've got a DK2 sitting on my desk, and it's my VR platform of choice.

On the road? It's a different story.

The biggest problem facing virtual reality is convincing people to try it. Every day I meet (whether online or in person) skeptics. "We've tried VR before," they say, or "I don't think this will ever take off." And maybe they're right.

But I've also met a fair number of people who were skeptical until they tried an Oculus Rift for the first time. I've also met tons of people who have no idea what to expect, don't even really understand what VR is, or are laboring under the misconception it's only for games.

What Samsung and Oculus have done with GearVR is make an ultralight, ultraportable demo unit. It's the perfect device to get people over the "try it, I swear it's cool" hump and give them their first taste of virtual reality. How do I know? Because I've taken it on trips and done literally just that.

Listen, I love my DK2 but anyone who owns one can tell you it's sort



of a nightmare to demo, especially on the road. It's a hydra of wires, especially once you add in the position-tracking camera, headphones, and a controller or mouse/keyboard. At any given moment, I'm using between two and five of my computer's USB slots for the DK2. That's not demo-friendly—both because it's intimidating to anyone who's not a hard-core PC gamer/tech enthusiast and because it's a huge pain to haul around.

The software experience? Just as bad. You're ever-conscious of the fact you're running demos that may or may not work on your machine. After

two years of VR I have a stable of favorites I trot out for people who're interested, but even then there's a 50-percent chance something goes wrong before we're done.

By contrast, no other VR device is as sleek or easy to set up as GearVR right now. Your Note 4 (or S6) simply slides into the familiar MicroUSB slot on the headset and clicks into place. Voilà. You're done. Put it on (it's not too heavy) and you can control all of the GearVR's functions with the controls on the side of the headset—a touchpad for swiping/tapping, a back button, and a volume rocker.

And because it's a phone, you can plug headphones right into the 3.5mm jack, pair a Bluetooth controller if you want, and off you go. There's no positional tracking unfortunately, but there is head tracking, thanks (again) to the fact that it's a phone with internal

Samsung GearVR Innovator Edition (Note 4)

AT A GLANCE:

Should you buy a GearVR? Eh.
Should you try a GearVR?
Absolutely. As soon as you can.

PROS:

- Makes an excellent (portable!) demo kit for virtual reality
- No wires

CONS:

- No guarantee Samsung will support old editions in the future
- Store not very extensive compared to the desktop VR community

\$200



gyroscopes.

Some other neat phone-only perks that aren't in the DK2: The back camera can act as a video pass-through, allowing you to walk around and do tasks with GearVR still on your face if you're so inclined. The front camera senses whether you've removed the device and automatically turns off the screen and pauses what you were watching.

My favorite addition is a built-in focus adjuster, though. With both the Rift DK1 and DK2, demoing to someone with glasses means literally removing the lenses from the headset and replacing them with a different pair. What happens when you remove the lenses? Well, if you're not careful hairs and dust fall inside and end up on the screen, and become an enormous pain to clean out.

GearVR with glasses? "Turn this knob until the words look clear." Brilliant, and something the Oculus Rift/HTC Vive consumer versions definitely need to ape.

It's also impossible to overstate how freeing GearVR feels with no wires attached. Even with SteamVR's single cord, I was constantly aware of something tethering me—and afraid I'd get tangled in it. With GearVR, I never have to pause someone's demo to say "Wait, you're getting wrapped by the cable. Spin the other way."

Software-side, GearVR is just as easy. When you plug the Note 4 into the GearVR headset it launches a VR-specific dashboard controlled by aiming your head at specific options and tapping

It's impossible to overstate how freeing GearVR feels with no wires attached.



Here's my
awesome
grandpa
checking out
virtual reality—
something I
never thought
I'd see.



the touchpad to confirm your choices. It's elegant and a far cry from getting kicked back to Windows after exiting a DK2 demo, or fumbling for a mouse/keyboard with the Rift over your eyes.

Even better, Samsung and Oculus created a fantastic “Welcome to VR” video that's the perfect demo for those who've never experienced virtual reality before. It's just a short little film (three minutes or so) that kicks off with you floating above Earth before running through a few other experiences (a Cirque du Soleil performance, a man playing music in a studio apartment, et cetera).

I've shown that film to probably three dozen people now, from teenagers to grandparents, from people who can barely work a cellphone to those who play games all day, from friends in San Francisco to distant relatives in Italy. Every single one of them, at some point during the video, has smiled and said something like “Wow” or “Fantastic” or (in the case of the aforementioned Italian relatives) “Bellissimo.”

And I get it, because that's how I felt when I first tried VR. The difference is I was strapped into a comparatively low-res DK1, wrapped in wires, and walking around the Unreal 4 demo.

There are a few other apps worth recommending, despite the

GearVR's paltry selection. Oculus's official movie app comes preloaded with some trailers and is an excellent showpiece for the potential of VR cinema—watching *Interstellar* on the moon, for instance. Darknet is a fun puzzler. Samsung's MilkVR app

updates weekly with new 360-degree videos, and is a great resource once you've exhausted the Welcome to VR video. And a few desktop favorites have been ported over—*Titans of Space* and *Ocean Rift* made it from my stable of DK2 demos to my stable of GearVR demos.

But all that comes later. First things first, you need to convert people to VR believers. GearVR is the best way I've found to start that process.

Do you need GearVR?
Probably not, unless you're
deep into virtual reality
already and are of the
“collect-them-all” mindset.

Bottom line

Do you need GearVR? Probably not, unless you're deep into virtual reality already and are of the “collect-them-all” mindset. There are too many unknowns for me to recommend GearVR as a consumer device—especially considering Samsung's bound to release an exponentially better version next year. Thus goes mobile development. Thus goes the breakneck pace of virtual reality.

That doesn't mean GearVR is bad, though. Far from it. GearVR is a fantastic device—and maybe the most important step VR's taken since the DK1, as far as consumer appeal. The problem is it only fills a certain, very small niche. One you probably (statistically) don't fit into. 🔌



The HyperX Cloud II makes the best sub-\$100 headset a little better

BY HAYDEN DINGMAN

LAST YEAR I CALLED the HyperX Cloud “one of the best sub-\$100 gaming headsets I’ve ever used.” Apparently not content with that, Kingston went ahead and released the HyperX Cloud II (kingston.com/hyperx/cloud) this year—a little pricier, a little more refined.

“Little” being the operative word here. Not much changed between the HyperX Cloud and its successor, but the two do differ in some key ways. Namely, the addition of a built-in USB sound card.

Lateral moves

In terms of the headset itself, the HyperX Cloud II is (as far as I can tell) identical to its predecessor. The colors have changed a bit, but it's otherwise the same premium-feeling metal-and-"leather" I loved from the first iteration. In my original HyperX Cloud review I said, "The solid metal construction gives this headset both a nice heft and a durability that's unmatched in the sub-\$100 range," and I stand by that statement.

And it's just as comfortable as before. The designation for this headset might've come from Kingston's partnership with the Cloud9 esports team, but "Cloud" is equally appropriate for the feel of the device itself. It's so cushy.

Unfortunately sticking to what worked last time means the Cloud II carries over some of the same sins as its predecessor. You can't rotate the earcups, which is a pain if, like me, you have a habit of pulling your





headset down around your neck. Also, the headset is fairly small—I had to extend the ears most of the way before it'd sit on my head.

Same pros as before. Same cons. Easy.

The main difference between the HyperX Cloud and Cloud II is the sound, thanks to the Cloud II's inclusion of a 7.1-ready USB sound card. The original Cloud, by contrast, terminated in a 3.5mm jack, with no way to adjust the headset's sound.

To be honest, it didn't really matter. Part of why I was so enthralled with the original HyperX Cloud was because it had amazing sound quality right out of the box. In my previous review I actually said "Kingston makes no attempt at a 'surround' experience, but the sound profile of the HyperX Cloud is better than that on a lot of the headsets touting the feature anyway," which makes the inclusion of 7.1 support in the Cloud II kind of funny.

And out of the box, the HyperX Cloud II has the same great sound. You can still plug the Cloud II into a 3.5mm jack provided you leave the USB sound-card attachment off, though you'll lose inline controls that way.

The inline controls are actually where Kingston's improved most on the original Cloud. The USB sound-card features big rockers for both headset and mic volume, as well as a 7.1 toggle and mic mute. I wish

The inline controls are actually where Kingston's improved most on the original Cloud.

Here's what the new USB sound card (with inline controls) looks like.



the buttons clicked more distinctively, and the mic mute can be a bit hard to slide back and forth, but it's a huge upgrade compared to last year's tiny volume wheel and the mute button that made a loud "PING" noise when you tapped it.

As for how much the sound card improves the sound quality? Again, "a little" seems most appropriate. While it's great you don't need software installed to use the sound card, that also means you're unable to tweak the sound profile to your heart's content like you can with other USB headsets.

The result is that using the HyperX Cloud II's sound card is more like a lateral move than a real improvement. Both the bass and the lower end of the mids have been boosted a bit from the original HyperX Cloud, while the highs are a bit less clear. Testing with music, especially, I noticed cymbal crashes getting lost in the mix—a clear sign that the highs are being scraped off the top.

As I said, it's not necessarily worse than the original HyperX Cloud's sound. I just don't know that I'd call it better either. It's a more games-oriented profile, whereas the original Cloud had a more rounded, jack-of-all-trades sound.

The 7.1 is, like most headsets, disappointing. I feel like I say this in every review of a 7.1 headset (probably because I do), but no headset



...the HyperX Cloud series as the best sub-\$100 headset you can buy, with audio that easily compares to some higher-priced offerings

is going to achieve proper surround sound. At best, you're getting an awkward simulation of it. Worse, the 7.1 introduces some static to the audio that's unnoticeable in loud situations but—to me, at least—somewhat distracting in quiet, reflective moments.

I honestly think the original HyperX Cloud with its stereo drivers did a perfectly fine job of simulating the sort of depth and positional tracking you'd want from a surround headset—without being a surround headset. The 7.1 here is a marginal improvement, in games that support it. It's not why you'd buy the Cloud II though.

What should make you buy the Cloud II is the fact that the sound card also improves the microphone. The Cloud II uses the same weird detachable microphone as the original Cloud (complete with that stupid rubber piece over the jack that you'll inevitably lose as soon as you remove it). Last year I complained that the Cloud's microphone was a piece of junk, thanks to a ton of problems with plosives and noise pickup.

The Cloud II's microphone isn't perfect, but it's complemented by noise and echo cancellation built into the sound card. Comparing mic recordings I made last year with some from the Cloud II, the difference is immediately apparent. The Cloud II microphone sounds like an entirely different (better) piece of hardware.

Bottom line

Should you buy the HyperX Cloud II instead of the Cloud? I don't know, to be honest. This is a pretty marginal improvement on last year—and at a slightly higher price. They're both fantastic budget headsets though, so it's really down to personal preference. Do an improved microphone and inline controls justify the higher cost for you?

Either way, I feel comfortable recommending the HyperX Cloud series as the best sub-\$100 headset you can buy, with audio that easily compares to some higher-priced offerings by SteelSeries and Astro. 🔌

Maingear Epic Force X99 with 4-way Titan X cards

BY GORDON MAH UNG

WHEN YOU THROW down a fat roll of Benjamins for a top-end gaming PC, you're going to want to feel like you got what you paid for it.

While the cheap—er, frugal—crowd will never agree on the cost, it's hard to believe anyone could disagree that Maingear's Epic Force X99 (go.pcworld.com/maingearepic) isn't one hell of an impressive rig.

One glance at the specs will have any hardware aficionado swooning: First, there's the Intel top-shelf Core i7-5960X chip overclocked to 4.5GHz, then there's the 16GB of DDR4 running at 2800MHz, and finally there's four GeForce Titan X cards.



Watch the
video at
go.pcworld.com/maingearepicvid



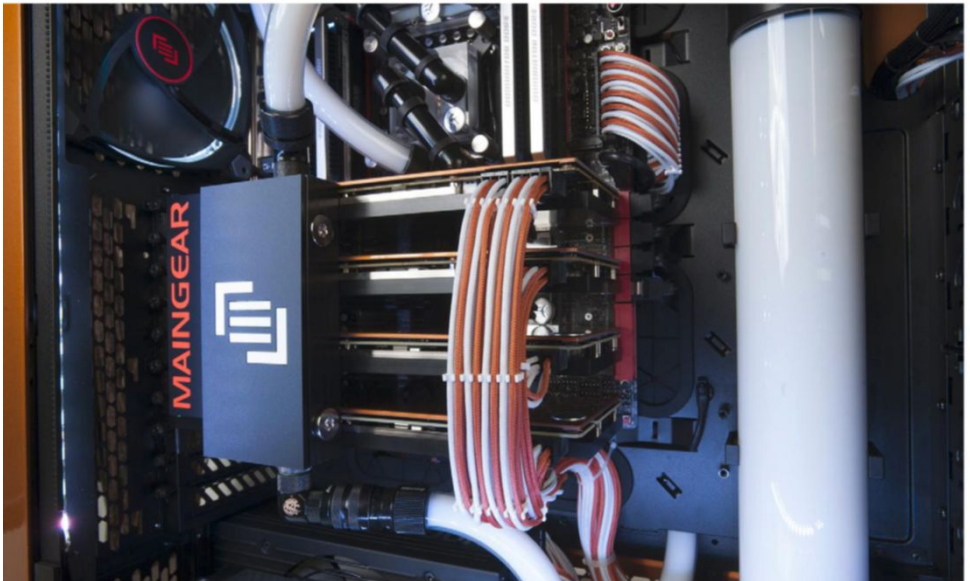
The liquid cooling really ties the room together

That's usually enough hardware to get anyone to agree that yes, this is bad-assery at its best. The real magic of Maingear's Epic Force X99, though, is the way it's all put together. There's no off-the-shelf cooling or air-cooled GPUs here. Instead you get incredibly beautiful liquid cooling.

After all, anyone can slap four \$1,000 video cards into a case and thumb the power switch. But liquid-cooling them and not having it all look like Mario did the job while jumping over barrels? That takes skill. The plumbing in the Epic Force X99 is so beautiful you almost want to kiss your fingers and wave your hands in the air while saying in a faux accent, *magnifique!*



Maingear doesn't just cool the GPUs in the Epic Force X99, it goes all in and puts water blocks on the voltage regulators and chipset, too.



The four GeForce Titan X cards stay quiet even after long loads, thanks to the full liquid cooling which also happen to be beautiful.



Even the motherboard is cooled

The liquid cooling isn't done with low-end parts: Maingear sources its water blocks from EK. The cooling also doesn't just stop with the GPUs—the company actually cools the motherboard's voltage regulators and chipsets, too.

The GPUs still get plenty of love, though. The water blocks are also sourced from EK and feature backplates that are custom-painted to match the exterior. The enlarged reservoir is used to minimize maintenance by customers, Maingear tells us, which is why the water loop is designed to be serviceable. Maingear said a customer could disconnect the GPUs and bypass them if they wanted to run different video cards without liquid-cooling down the road. This class of customer, though, will probably just ship it back to Maingear to have the cards replaced.

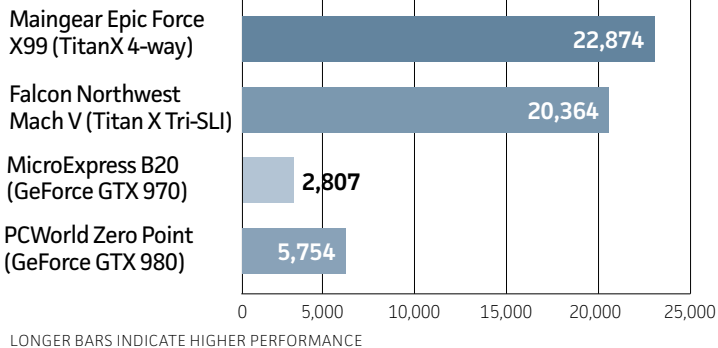
Performance matters, too

All this would mean nothing if the Maingear Epic Force X99 didn't perform. You needn't worry: In gaming, it's simply the fastest system

Maingear's

Epic Force X99 is a custom liquid-cooled beast with four Titan X GPUs.

3DMark FireStrike Extreme Overall



The multicard systems easily race away from the single-GPU systems, but we also see the dividends gets much leaner going from three Titan X cards to four of them.

we've seen to date. Like all facts though, that's meaningless without context.

For example, in the synthetic graphics test 3DMark FireStrike Extreme, it destroys our zero-point system with its single GeForce GTX 980, but you'll see the Epic Force's score isn't exactly a death blow to the Falcon Northwest Mach V reviewed (go.pcworld.com/falconmachv) with its three Titan X cards. That's because the Maingear (and the Falcon, too) begin to run into multicard GPU scaling issues that make the return on investment pretty lean.

Going from one card to two will probably net you an 80 percent increase in performance. You'll get less going from two to three, and the payouts dwindle even further going from three to four GPUs.

Scaling issues

You can see scaling issues in *Middle-Earth: Shadow of Mordor*. In this comparison chart, I've lined up the 4-way Epic Force X99 against the Mach V with its three Titan X cards and also threw in the result from our GPU test bed, a Core i7-5960X with a single Titan X installed. Running *Middle-Earth: Shadow of Mordor* at 4K resolution with the HD

texture pack installed you get a little more than a 20-percent performance increase going from three cards to four. That's really not bad. But then, a single Titan X gives you 35.6 fps; if it scaled perfectly, three cards would have been about 106 fps and

four really would have been 142 fps. Multi-GPU scaling will vary from game to game and depend on the resolution you're playing, but generally it decreases as you climb above two cards.

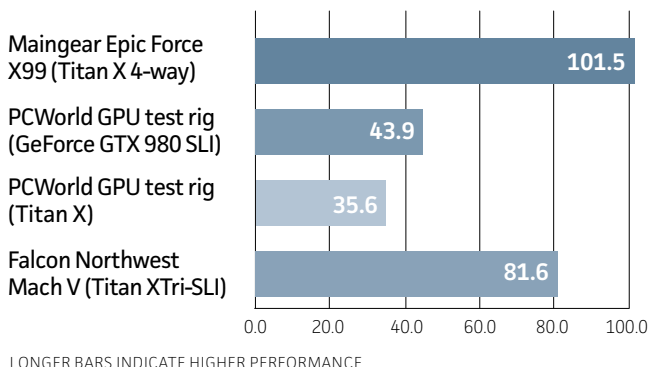
That's the way multi-GPU setups have worked since the beginning. We've never gotten 100 percent scaling. Four GeForce GTX 980 cards, for example, probably would perform at or below three Titan X cards.

CPU Performance

When you move beyond gaming performance, the Maingear hangs right there with the other Core i7-5960X-based 8-core systems. For example, in our Handbrake test, where we take a 30GB MKV high bit rate and convert it to a tablet-friendly format, the Epic Force X99 is just about dead-even with the Mach V system. Both run the same Intel CPU at the same overclocked speed of 4.5GHz. That's a testament to what Falcon is able to do with what is essentially an off-the-shelf, closed-loop cooler compared to the complicated custom liquid cooling in the Epic Force X99 box.

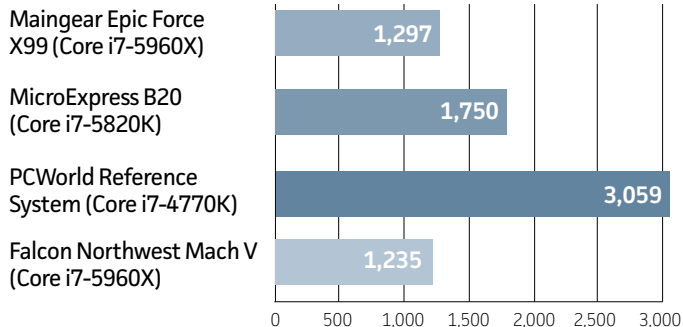
The Epic Force X99 definitely looks cooler, if that matters to you and, frankly, it usually does to most people shopping at this end of the spectrum. The liquid cooling on the Epic Force X99 also keeps it

Middle-Earth: Shadow of Mordor (4K)



In real-world gaming at 4K resolutions, you can see the scaling get smaller as you go from one Titan X to three and, finally, to four cards in the Maingear box.

Handbrake 0.9.9 (sec)



LONGER BARS INDICATE HIGHER PERFORMANCE

The Maingear Epic Force X99

and its overlocked Core i7-5960X eats the quad-core and hexa-core systems but the Falcon Northwest Mach V is just a bit faster.

quieter than the Mach V. The Mach V is surprisingly quiet for a three-GPU system but it can't compete with a full liquid-cooling setup, so that's definitely a win for Maingear.

Maingear Epic Force X99

PROS:

- Beautifully crafted gaming rig
- Elegant liquid-cooling system

CONS:

- At this point, why not round it up to \$11,000?
- RAID 0 SATA SSDs seem antiquated
- Turns your laptop into a desktop

\$10,980



Whiners, we're just whiners

We can't let this review go without criticism. However, the two things I want to complain about may not be within the control of Maingear. The first is storage. The Epic Force X99 came with three 256GB Samsung 850 Pro drives in RAID 0 and a 3TB Seagate hard drive. That's about a 1GBps of read speed from the RAID array which would be impressive if this were 2013. In



The lower section


houses one of two radiators in the Epic Force X99.

the age of 2.7GBps read speeds from a single Intel 750 drive, it's a bit of a yawner. The issue, of course, is how to get an Intel 750 drive to even work in a system this heavily packed with hardware. You can read more (go.pcworld.com/toofastssds) about this problem.

The other complaint is the lack of a custom chassis. The paint job is exotic-car quality, with enough clear coats to feel like it's bathed in butter. But the chassis, besides a custom front face plate, is an off-the-shelf Corsair 900D case. It's a bit like wearing an off-the-rack dress with some touch ups to the Oscars.

To be fair, vendors who have chased custom cases sometimes find it to be a major headache or bankruptcy-causing move, so maybe this is actually the smarter move. I'm also not sure any one can tell this is an off-the-rack case.

Conclusion

Ultimately what you get from the Epic Force X99 is the look and feel of a custom-modded machine you'd be proud to show off without having to put the blood, sweat, and tears into actually having to build it. As someone who's done it before and succeeded and failed, sometimes it's just a lot easier pick up the phone and order one. You just have to have the funds to do it. 



Watch the
video at
[go.pcworld.
com/
lumia640vid](http://go.pcworld.com/lumia640vid)

Microsoft Lumia 640: practical Windows Phone

BY GORDON MAH UNG

MICROSOFT'S LUMIA 640 (go.pcworld.com/lumia640) is the tract home most Americans pretend to shun but end up buying anyway: friendly, unpretentious, with an exterior that cheerfully advertises something different in just a few stock colors.

Inside, it's the same home as the rest of the block, with a few upgrades. Think of the new Windows Phone 8.1 Update 2 that powers it as the granite countertops and track lighting of Microsoft's suburbia. And it's cheap: just \$130, according to Cricket, the first carrier to offer the phone. There's even a move-in special, a free year's subscription to Office 365 Personal worth \$70 if you buy the phone before June 30.

Once you're settled, though, chances are you're going to feel a bit cramped. Neighbors in the Android and iOS clubs may titter and point

to the Lumia 640's dowdy display. And always, always you'll glance up enviously at the more luxurious homes dotting the hills: the Lumia 830s, Icons, and 930s. But thread your way through the mountains of photos that clog your living space, ease past the massive apps that fill your bedrooms, and take pride in the fact that you saved some cash.

Just clearing the hardware bar

Lumia phones seem to ship in one of two varieties: chunky, solid flagship phones, or the candy-coated, plasticky cheaper variants. Measuring 5.56 x 2.84 x 0.34 inches and weighing 5.1 ounces, the Lumia 640 is one of the latter, with a slick plastic backing that probably should be textured to add a bit more grip.

The phone's 1280 x 720, 5-inch IPS display fits well in the hand, but can't hold a candle to the exquisitely detailed displays that iOS and Android phones tout. Don't write it off just yet, though: Apps render just fine. The only real annoyance I experience with low-res Windows Phones is that webpages displayed via Internet Explorer can require you to turn





on Reading Mode before the font is large enough to read comfortably.

In fact, the Lumia 640's display, internal processor (a 1.2GHz quad-core Snapdragon 400), and memory (1GB RAM) are identical to last fall's Lumia 830 (go.pcworld.com/lumia830). Benchmarks were nearly identical, too: SunSpider 1.0.2 (1.24 s), Antutu 0.8 beta (11,123), and WPbench (237.72) were all about half the performance of the Lumia Icon, with its 2.2GHz Qualcomm Snapdragon 800 chip. As with the Lumia 830, we used *Asphalt 8: Airborne* as an informal games metric, and the performance was a bit stuttery, but not unplayable.

The Lumia 640's rear camera (eight megapixels) is a step down from the 10MP model that the Lumia 830 offered, and the 0.25-inch sensor inside it is slightly smaller than the 0.29-inch sensor inside the 830, meaning that it captures a bit less light at twilight and in dimly lit rooms. A dynamic flash feature supplies enough light to reveal the detail on night shots, but just barely. You can either use the 0.9 MP front-facing camera for selfies, or the nifty Lumia Selfie app to automatically orient the rear camera for a higher-res shot.

The Lumia 640 also lacks a dedicated camera button, tossing aside one of the Lumia line's signature features. Microsoft seems to have forgotten that its phone explicitly asks you for a numerical PIN to unlock it, which takes time. It took 10 seconds to unlock the phone,

A composite night shot shows the low-light capabilities of the Lumia 830, the new Lumia 640, and the Lumia 930, respectively. Automatic settings were used, with no flash.

launch the app, and take a picture. Compare that to an older Lumia 930, equipped with the quick-launching Lumia Camera feature and a dedicated button—that took just 2.5 seconds to shoot. That's the difference between capturing a baby's first smile and losing her attention entirely.

In addition to the camera button, the Lumia 640 jettisons all other hardware buttons as well. You'll need to swipe up from the bottom just to see the Windows or back buttons. It's a slight annoyance, but nothing too inconvenient.

About the only compromise that feels egregious is the relative lack of onboard storage. At just 8GB, that's already pushing it, compared with the 16GB or 32GB offered by most modern smartphones. And the actual storage amount that's available for use—about 3.54GB, with just Facebook installed—feels tiny, especially if you like to take lots of photos and high-definition video. Still, unlike many phones today, an SD card slot is included, and photos and videos can be backed up to the terabyte of OneDrive storage that comes with that Office 365 subscription. The real concern are apps: You can install an app from an SD card to the phone, but beware of downloading too many games like the 962MB *Asphalt 8: Airborne*—your available disk space will evaporate quickly.

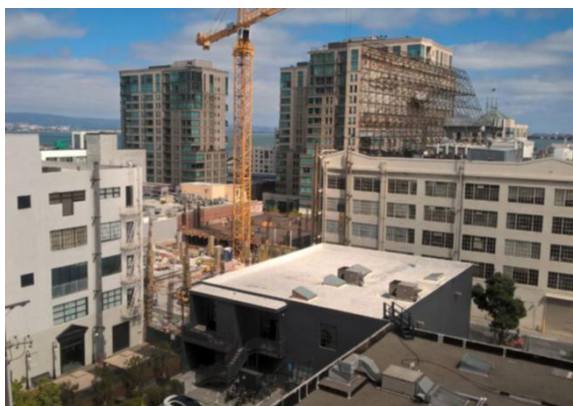
Battery life, however, has improved, in part due to the larger 2,500mAh battery that Microsoft included. That's good enough for 36 days of standby time, 17.5 hours of 3G talk time, and 10.8 hours of browsing via Wi-Fi, according to Microsoft. It easily cruised through a day's use.

Windows Phone 8.1 Update 2 adds order

With Microsoft releasing test builds of Windows 10 Mobile every few weeks, playing with an update to

Battery life, however, has improved, in part due to the larger 2,500mAh battery.

A shot with the Lumia 640, using the flash, but otherwise set to Auto.



Windows Phone 8 is a bit surreal. After all, there's nothing stopping you from freely downloading the next stage in Windows Phone's evolution. Unfortunately, you can't use this phone with the upcoming, PC-emulating Continuum for Windows 10 Mobile, as it will require new hardware. (The Lumia 640 will support Windows 10, just not Continuum.)

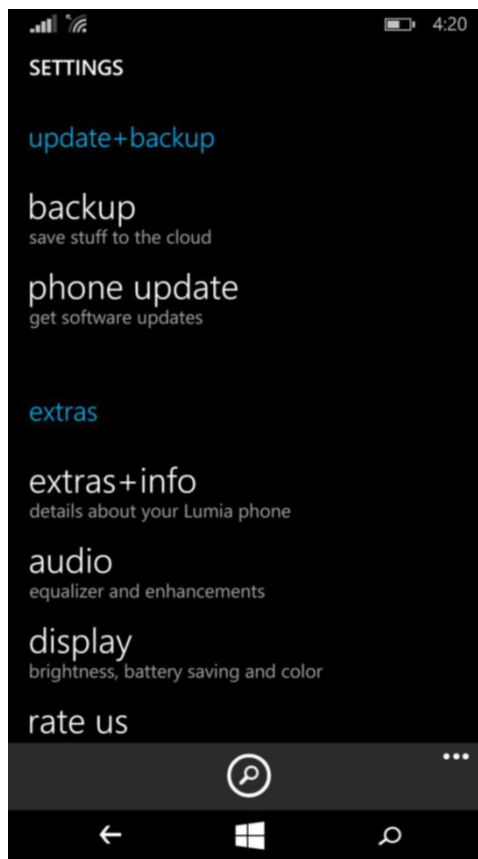
You'll appreciate the little touches that Windows Phone 8.1 Update 2 offers, though they're not monumental enough to sell the phone by themselves. If nothing else, you'll appreciate that the Settings menu finally has some rhyme and reason to it—and if you still can't find what you're looking for, a new dedicated search button should solve the problem.

The phone's motion tracker does a nice job of tracking your steps (it recorded about 8,400 steps when my Microsoft Band tracked 8,200 for the day) and automatically keeps track of how far you bike and drive, too. The glance screen now offers numerous options, and you now have control over app permissions—what apps get access to specific phone functions. Unfortunately, the Lumia 640 lacks the “Hey Cortana!” active-listening feature available on the Lumia 930.

The Lumia 830 is arguably a better phone...but

Aside from the caveats I've listed above—especially the limited storage—I see nothing truly wrong with the Lumia 640. I just think that you'll be happier with the Lumia 830.

Right now, however, Cricket's offer for the Lumia 640 is also dramatically cheaper: By my math, it works out to \$1,210 for two





years of 5GB/month service, including the \$129.99 up-front phone cost, plus taxes and fees. Two years of AT&T Next 24, plus the price of the Lumia 830, will cost you \$3,080.16. (AT&T and T-Mobile have announced that they'll carry the Lumia 640, but as of this review have yet to announce pricing.)

By that metric, you may find yourself quite willing to put up with any quirks that the Lumia 640 offers. I will argue stridently that you'll enjoy the Lumia 830 more. But in the midrange phone space, price can be a major sticking point. In that regard, Microsoft's staunchly midrange Lumia 640 may be the right phone for you. 🔌



Android Auto: The best way to get Google Maps in your car

BY FLORENCE ION

I LOVE ANDROID, I love cars, and I love driving, so I was pretty excited when Google announced Android Auto (android.com/auto). And after using it for several weeks and giving the test vehicles back to their owners, I kind of miss it.

Android Auto is still very much in its early stages. Unlike a smartphone, which you can easily trade in for a newer model, Android Auto requires more commitment. You have to either buy a car with an in-dash infotainment system that's compatible with the software or pay to have it installed in an aftermarket setup. It isn't cheap, and it's not easy to swap out for something else.

Once you have it in your car, you'll soon realize it's lacking some of the features it really needs to feel whole. And sometimes, it responds

inconsistently to your commands. But I realize how much safer it is to have a big screen with Android in the dashboard of my car than the smaller screen-size of the smartphone in my hand, and it's super convenient having Google's apps and services readily on tap.

The first drive

I've always believed that driving a car should be a pleasant experience, but driving a car with Android Auto will, at first, be a test of your patience. You can't always just get in the car, plug in your phone, and drive off.

I tested Android Auto in a 2015 Hyundai Sonata, which came with it installed off the lot, and in an aftermarket Pioneer (go.pcworld.com/androidauto-pioneer) unit. In both cases, the car starts up by default in the receiver's proprietary interface. From there, you have to tap the button for Android Auto, which pops up only after the phone is properly connected. It has to be tethered via USB *and* connected via Bluetooth to work.

I used two Galaxy S6 Edge devices during the review process and



Watch the
video at
[go.pcworld.
com/android
autovid](http://go.pcworld.com/androidautovid)



both had issues in the beginning staying connected to the receiver. A slight jiggle of the cord in the Sonata would disconnect Android Auto completely, while the Pioneer head unit took minutes to register that the phone was even plugged in. I've been late to everything since I started testing out this software. Conversely, the Nexus 6 running stock Android 5.1 worked like a charm every time. I don't know if it's because one phone runs stock Android and the other runs both Android Auto and Samsung's Card Mode at the same time, but hopefully this isn't another tale of Android fragmentation.

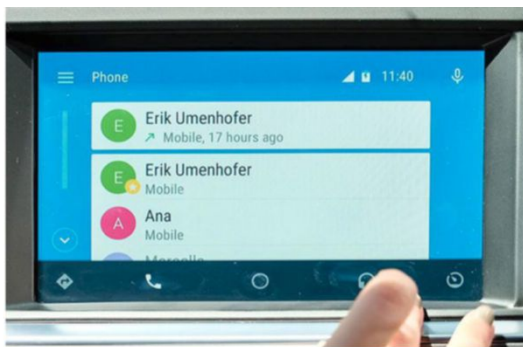
To be fair, once I figured out Android Auto's connection requirements—like making sure not to bump the cord connected to the Galaxy S6—it worked just fine. You simply tap around and select what you need, or hit the voice-command button on screen (or on the steering wheel, if your car supports it) and ask it to do something, like you would your smartphone. In the Sonata, Android Auto was mostly fast and responsive. In the aftermarket setup, it sometimes struggled to keep up with my tapping. In both cases, there were times when the

On third-party Android phones, a little notification appears on the Lock screen to let you know Android Auto is connected.

interface was too slow to respond to what I had asked it to do simply because I didn't have a good cellular connection.

The nice thing about Android Auto is that if you're a seasoned Android user, there's a sense of familiarity. The Home screen, where all your basic information pops up, looks exactly like Google Now on your phone. The heads-up notifications pop in just like they do on Lollipop. If you want to make a phone call, your Contacts list is readily available, with your favorites pinned up at the top for quick access. And if you need more options, the recognizable overflow button (the "hamburger" or three horizontal lines) sits in the upper-left side of every app.

Android Auto borrows much of Google Now's context awareness to help you out during your drive, too. Once the app is booted up, you'll see a helping of suggestions on the Home screen. For example, if Google Calendar knows you're due somewhere at a certain time and



The interface is true to Google's material design.



Android Auto's Home screen will pop up with relevant, contextual information for the journey ahead, just like Google Now.

it's tagged with a location, Google Now in Android Auto will immediately offer a shortcut to get navigation through Google Maps. Just tap it and you're on your way.

I should also mention that Android Auto is somewhat aware of the state of your car. You can use the keyboard functionality only when you're parked, and not while you're en route to the grocery store. I actually pulled over a couple of times just to type something in—this typically happened when I was getting directions somewhere and I couldn't recall the address to shout it out loud. It's a good safety feature, but what if you have someone in the passenger seat who could type something for you? There's also a neat inverted night mode that flips on when you go through a tunnel or it's time for the headlights.

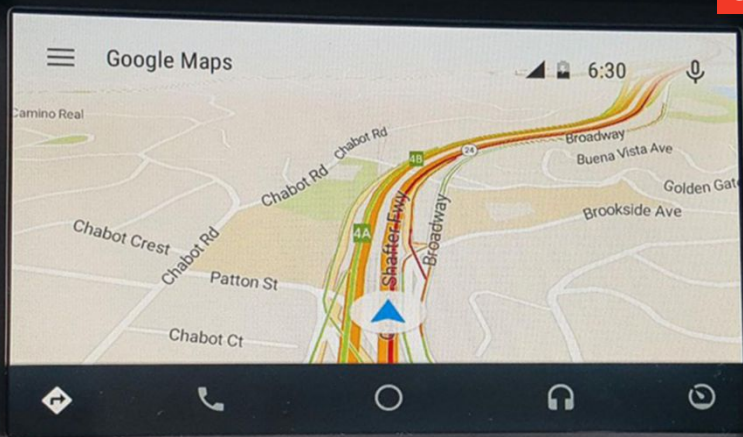
Voice command through the car

Right now, Android Auto is only good for three basic things: navigating around town, making a phone call, and playing music. You can also ask it to tell you if the San Francisco Giants are winning while you're stuck in traffic, but anything more complicated than that and Android Auto gets a little confused.

I know we're gravitating toward a hands-free usage situation in our cars, but I often preferred using the touchscreen to control Android Auto rather than shouting out commands. I never knew the precise phrase to ask Android Auto to get it to do what I wanted. If I wanted a specific playlist in Spotify, for instance, it just wouldn't understand me. If I asked it to send a text message without using the exact correct phrasing, it'd tell me "I'm sorry. I don't understand that command."

"Okay, Google: Do you understand anything I'm saying right now?"





The only voice commands I felt confident using were asking it to find me directions someplace or place a phone call. Afterwards, I'd have to peer over to the screen to make sure it was doing what I asked. That part was distracting. Even while driving fast down the freeway, I'd take my eyes off the road just to ensure Android Auto wasn't tripping up on my command.

I've never liked dictating text messages, and I especially hated doing it with Android Auto. It's frustrating when a computer can't understand what you're saying, and it's even more so when you're on your way to your parent's house and all of a sudden there's an issue they decided to text about rather than call. At times, I would resort to asking my passenger to pick up my phone, unplug it, and send a text message for me. It also didn't help that Android Auto doesn't yet understand the concept of bilingual text messages. It butchered almost every text message conversation between me and my immediate family.

"Looks like you've got a lot of bumper-to-bumper ahead of you. Just chill and bump your favorite tunes."

Navigating with Google Maps

Obviously, Android Auto taps into the power of Google Maps for its navigation abilities. This is absolutely its best feature. I loved it; I loved the live traffic updates and the ability to choose different routes. I love

the fact that Android Auto knows where my home and workplace are, so I could just shout, “Take me home!” and it’d launch into turn-by-turn directions of the fastest route. I tried using the Hyundai Sonata’s built-in maps application for comparison and it was so unintuitive. Google Maps is simply superior, and it had all my previous locations pulled from my phone for fast and easy navigation.

There are still a couple of things Google should consider beefing up in Android Auto’s Maps application, however. For instance, I’d like for the Street View to pop up when I arrive at my destination. Oftentimes I have no idea what my destination address looks like, so having that frame of reference, as I do on my phone, would help a lot.

I’d also like to see full Waze integration of some sort, especially since Waze isn’t yet available as an individual application supporting Android Auto. Waze’s integration in Google Maps would also be useful; in the mobile version, there are icons that denote whether there’s an accident or construction up ahead. You can typically tap on them for more information. You can’t currently do that in Android Auto. Having that kind of up-to-the-minute traffic information is essential when you’re stuck on the road.



I love the options available in the Google Maps app on Android Auto.

Android Auto’s app problem

At present, there are only a handful of applications available for Android Auto and their features are sort of limited. With Spotify, for instance, you have access to a wealth of playlists and radio stations, as well as the ability to choose from any artist or album that’s available with the service. But Spotify is frustrating to use with the voice

Of the myriad music apps I have installed on my phone, only these three were available to me in Android Auto.



command functionality, and I often defaulted to Google Play Music merely because it understood me more often.

I don't just use Spotify and Google Play Music, though, so the limited selection of available music apps started to bug me after a while. I subscribe annually to Digitally Imported (di.fm), and many of my favorite DJs upload "mix tapes" of sorts on Soundcloud (soundcloud.com), but those apps are missing Android Auto compatibility. If I want to listen to them on my journey, I have to stop Android Auto and switch to the receiver's auxiliary mode. That's not any better than the Bluetooth setup I have in my own car. Granted, Digitally Imported is one music application out of hundreds in the Google Play Store, but I'd like to be able to control it from that massive touchscreen in the middle of the car rather than consciously hiding the phone from the California Highway Patrol while shuffling through songs.

I do want to clarify that I don't think Android Auto needs to be as functional as a smartphone. The whole point of the platform is to keep you from driving distracted. It doesn't need Facebook and Twitter, and it certainly doesn't need YouTube. What it needs is for Google to work with developers to get more popular music and location-based apps coded so that they're compatible with Android



Auto. I would love to see FourSquare and Yelp compatibility, too, because those are apps I normally use to find a place to eat. As over-the-top messaging continues to grow, the ability to send messages other than SMS texts and Google Hangouts will also become more important.

At least the apps that do work offer a glimpse into the platform's potential. The idea is that every app has limited functionality so that you're not tinkering with it when you should have both eyes on the road. I appreciate that philosophy and I'm looking forward to seeing more applications becoming compatible with Android Auto, but like all first-generation products, it's going to take a little while.

Android Auto
became my
friend in
bumper-to-
bumper traffic.

Is it worth the money?

My opinion of Android Auto fluctuated back and forth over this last month. I hated it in the aftermarket Pioneer setup. It was buggy and slow and reminded me why I never got an infotainment system installed in my car in the first place. But then I spent two weeks with

the Hyundai Sonata and it grew on me. Android Auto became like a fixed passenger in my car. We were buddies for this last month. I even started talking to it, because it gets lonely in bumper-to-bumper traffic. It took me to Napa, to San Francisco, and back home every time. It helped me more easily find parking around the city and kept my phone charged the entire time. I haven't had a low battery in a while!

And then comes the caveat: I won't have Android Auto in my car for at least eight years. I don't plan on buying a new car any time soon and my current one isn't compatible with the aftermarket setup. It's a bummer, because Android Auto just convinced me that having that in-dash display is so much safer than peering down at my phone every few minutes.

I really hope that Android Auto doesn't become as fragmented as the Android mobile platform is now, but I also hope it doesn't stop evolving. We really have to stop using our smartphones behind the wheel. I see people every day on my drive in to work using their phones while cruising in the fast lane. You're already putting your life at risk by getting in a car. I know it's grim to think about, but I'm a firm believer that anything we can do to eliminate distractions and simplify our lives is worth the investment in the long run.

So, if you're car shopping, take a look on their site (android.com/auto) at the current list of manufacturers who have committed to Google's in-car software and see which fits you the best. If the car maker you were thinking of going with—like Toyota, for instance— isn't on the list, don't change your car-buying plans just for this software.

But, if you already own a car that's compatible with an aftermarket setup, and you're really tied to the Google ecosystem and like the idea of Android in your car, you might want to price out how much it would cost to overhaul your dashboard. The safer driving experience is definitely worth it, and at least you'll be prepared for the next major update. 🔌

Voyce is the wellness monitor for dogs that makes wearables vividly relevant

BY JON PHILIPS

EVEN IF YOU RETIRED YOUR FITBIT or Fuelband to a desk drawer long ago, you may still find room in your heart for another activity-tracking wearable. No, not for you—for your dog. The Voyce health and wellness monitor (go.pcworld.com/voyce) bypasses human biology entirely, and sets its sights on *Canis familiaris*, a species with much less capricious technology habits.

Yeah, it's another canine wearable. But instead of merely recording pawsteps, the Voyce band also tracks resting heart and respiratory rates, two biometrics that can provide deep insights into a dog's



Watch the
video at
[go.pcworld.
com/voycevid](http://go.pcworld.com/voycevid)

health. My border collie mix, Whiskey, has been wearing Voyce for just over a month, and I've gathered a wealth of interesting data about just how much activity and sleep she's really getting—along with reports on her vital signs that would otherwise require specialized veterinary equipment.

Voyce just dropped its price from \$300 to \$200, but requires a pricey \$15 monthly or \$150 yearly membership plan. It's also limited to dogs with 12-inch necks or larger. It's also got an annoying, ever-blinking LED, and looks like cold, sterile medical equipment. And the Voyce data dashboard is web-only, and loads rather slowly.

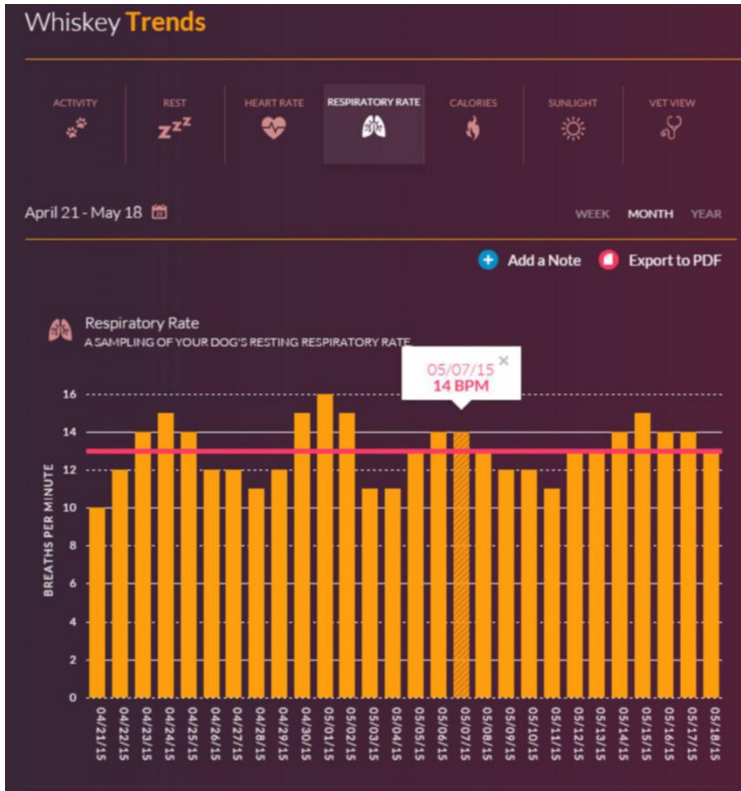
The manufacturer, i4C Innovations, says it's working on fixing some of these issues, but even the 1.0 version of Voyce is supercool technology. The collar tracks Whiskey's heart rate and breathing when she's at home, kicking back on the couch—cool, calm and perfectly content. And this is the big innovation that should be of particular interest to veterinarians.

A month's worth of doggie data

The collar was originally slated to be available by summer 2014, but Voyce hit a snag with FCC approval. The device's special patented



The Voyce collar quickly picks up scuffs, making an already industrial-looking band look a bit more janky.



Here's a month of Whiskey's respiratory data. It would be nice if Voyce added days of the week to its calendar view.

technology is a sensor that uses low-frequency radio waves to measure heart rate (tracking pulses of the carotid artery) and breathing rate (tracking muscle movement in doggie's chest). The FCC finally landed on a protocol for testing and certifying this application for dogs, and now the Voyce band is shipping.

Every day for the last month, I've been checking Whiskey's heart rate and respiratory data, and her readings have been blissfully normal. I haven't seen any alarming heart rate spikes, and her breathing rates have varied between a relaxed 11 and 16 breaths per minute. The Voyce band takes these two readings when your dog is at full rest, and then reports a three-day rolling average.

This rolling-average approach smooths out the natural variability of canine heartbeat and breathing rates, presenting only baseline measurements that can show trends over time. But here's the really important thing, according to Voyce: Because the measurements are collected when your dog is perfectly calm, the readings will be much more instructive than anything measured during the cortisol-driven emotional duress of a veterinary visit.

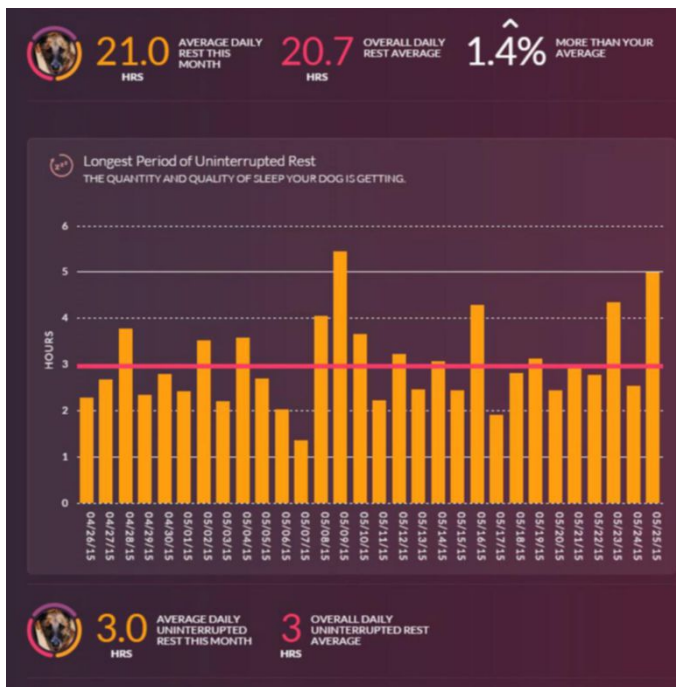
To this end, the Voyce platform includes a Vet View that gathers up all relevant data and exports it to PDF. You can then send the file to your pet doctor to provide him or her with a deeper level of diagnostic insights. Voyce says its technology is greater than 90 percent accurate when compared to a Holter monitor (go.pcworld.com/holter) or Televet (go.pcworld.com/televet). These unwieldy veterinary devices measure a dog's heart rate at rest, but just aren't practical for continuous, everyday use.

Progressively shorter periods of uninterrupted rest might indicate your dog is in pain.

What trend data can really tell us

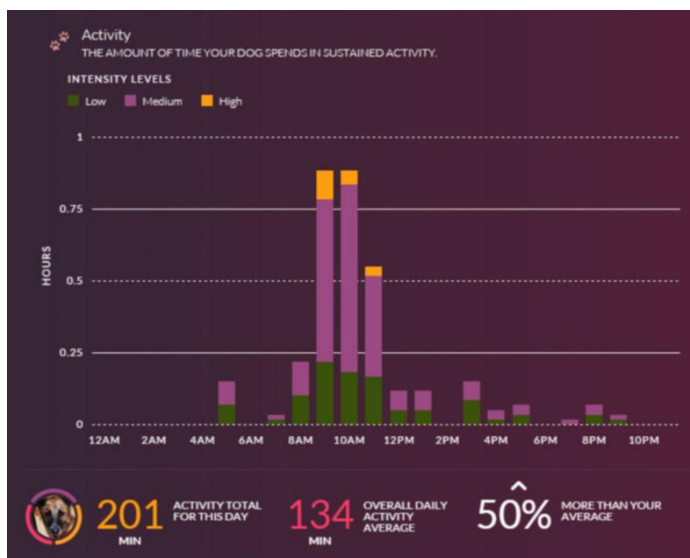
If you check your dog's Voyce data regularly, you may even be able to spot a developing medical problem. To this end, Voyce gives your dog a new voice in her own health and wellness effort.

For example, elevated heart rates can be an indication of pain, fever, or



infection. Elevated respiratory rates might suggest a heart problem or an issue with your dog's endocrine system. The Voyce platform also reports your dog's longest periods of uninterrupted rest. So, if you notice these periods are getting shorter over time, your dog may be suffering from arthritis, hypothyroidism, or even cancer pain.

If you see sudden spikes or gradual upward swings in either metric, you shouldn't panic, but rather take the data to a vet who can triangulate heart and breathing rates with rest and activity data. Amanda Landis-Hanna, i4C's Director of Veterinary Medicine, describes a scenario: "If I see that resting respiratory rate jump from, say, 12 to 25, I know there's something that I need to have a conversation about. If the resting heart rate normally hangs out around 60, and suddenly jumps up to 100, 110, 120—all of which are very elevated in a resting



On the day we shot Whiskey's Voyce video, she got 50 percent more than her normal daily activity. Here we see an hourly breakdown.

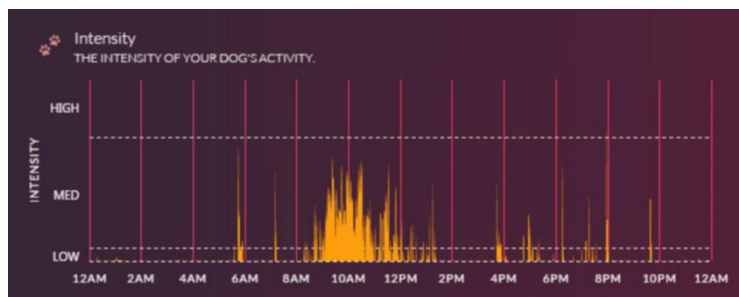


Whiskey never demonstrated any discomfort wearing the Voyce, but it looks a bit like a shock collar or a GPS tracker for parolees.

patient, but normal in a stressed-out patient in my hospital—that’s important information.”

The Voyce team doesn’t want to turn pet parents into hypochondriacs, so the platform includes a library of professionally sourced articles on health, behavior, and nutrition, among other topics. There’s also a symptom checker tool to help users identify specific problems.

“What we’ve found with the pet parents who are using Voyce is not that they’re trying to diagnose their own dog, but that they feel much more in tune,” says Landis-Hanna, who’s been a practicing vet for 13 years. “They’re tracking trends, they’re reading the articles and better educating themselves, so that when they go into the vet office, they feel they’re speaking the same language. And a better educated client is generally more compliant, meaning if I can explain the benefit of blood work or X-rays, the pet parent will do those if they’re able to, getting us closer to the diagnosis.”

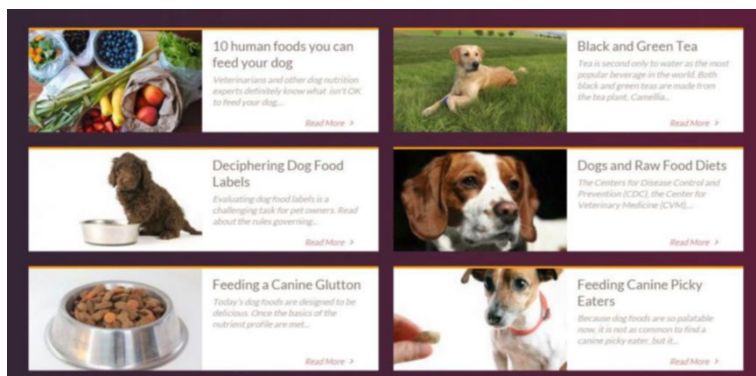


This graph charts the intensity levels of Whiskey’s activity on the day we shot her video. Clearly, the Voyce team likes its charts and graphs.

Deep dives into activity and sleep

Throughout my testing, I sifted through Whiskey’s data with interest, observing how much exercise she was getting at doggie daycare on weekdays versus time spent at dog parks on the weekends. The Voyce dashboard’s activity data shows periods of low, medium, and high intensity levels, as well as estimates of miles covered, all based on accelerometer readings. It doesn’t, however, show actual pawsteps. In other words, it’s not Fitbit for dogs.

Among other services, your subscription fee pays for a growing collection of articles written by vets, behaviorists, nutritionists and other experts.



Nonetheless, it was interesting to observe that Whiskey's activity during really busy daycare visits exceeded her activity when I only gave her two 35-minute walks on a really lazy Sunday.

The dashboard doesn't report sleep like a human activity tracker would. Instead it reports rest, which combines actual sleep with simple sedentary activity like kicking back on the couch and waiting for the fun to begin. I was surprised to discover that Whiskey's average daily rest count is 21 hours a day. That exceeds the estimated 80 percent of combined sleep/rest time that's taken root as conventional wisdom, but Dr. Landis-Hanna confirmed that Voyce is showing most dogs aren't quite as active as experts have always believed.

For what it's worth, I'm not worried that Whiskey is under-exercised. Looking at my Voyce dashboard, I can identify her most active days and correlate her numbers to nighttime behavior. On the days when Whiskey has even approached 20 percent activity time, she's been absolutely wiped out at night, suggesting she's passed her limit.

The dashboard also shows an estimate of calorie burn (helpful if you've identified a weight gain problem), and reports how many hours your dog has spent in direct sunlight. This last metric can prove especially useful if you're concerned your dog walker isn't doing his or her job.

Depending on the data set you're looking at, the dashboard can show you daily, weekly, monthly, and even yearly views. So, for

example, when you're in the daily view, you can check to see the precise times when your dog was active and enjoying sunlight. The monthly view is available for all data sets, and is most helpful for spotting health trends. That said, I wish the dashboard mapped calendar dates to days of the week. This would make it much easier to compare weekday activity to the same metrics on the weekends.

A portal for all your dog's details

The Voyce dashboard is packed with features. In addition to tons of interesting articles (for example, "Can my dog handle group walks?" and "How to train a rock solid recall"), there's a goal-setting tool (for instance, lose 5 pounds over three months) as well as a function for setting reminders for vaccines, appointments, and routine care. You can also log all of your dog's health and nutrition details, such as which shots are up to date, what she's allergic to, and exactly what kind of food she eats.

Your subscription fees cover all these features, and also pay for storing your dog's data on the Voyce servers. It's a robust platform, but it's worth noting that all popular human wellness wearables

The collar locks
on to your dog's neck with a burly, clacking fastener. It's not pretty, and the Voyce band doesn't currently support toy breeds.





Imagine this bright LED entering your room in the middle of the night while you're sleeping.

come with free monthly cloud service. As for the dashboard itself, it's easy to navigate on a desktop display, but it loads too slowly. I often found myself impatiently waiting for Voyce's servers to update Whiskey's charts.

Another gripe: There's no mobile app. Instead, the website employs a "responsive" design that automatically adjusts the user interface for smaller devices like tablets and smartphones. It sounds good in theory, but the render on smartphones is cramped and not intuitive. I also found the phone experience amplifies already annoyingly slow load times. On the upside, Voyce says it's working on a mobile app that will enable push notifications and other niceties we've come to expect from activity tracking apps.

Not the wearable for dainty dogs

As for the collar itself, well, let's just say it's not ready for Project Runway. I want Whiskey's coat to look lush and healthy, but I'm not interested in doggie fashion, so Voyce's cold, institutional aesthetic doesn't bother me (and I know it doesn't bother Whiskey). Still, its

general look and feel evokes a shock collar—or possibly even a GPS monitor that you might see on a criminal under house arrest. It's not a glamorous look, and that might be a deal breaker if you named your dog Princess or Buttercup.

Battery life is rated for seven days, and I found this estimate to be accurate. The collar is waterproof down to one meter, so feel free to enter DockDog competitions. Data syncs with Voyce's servers over Wi-Fi every four hours or on-demand via a button press. You can add up to 10 Wi-Fi networks, allowing you to sync pretty much everywhere your dog regularly visits.

The Voyce collar currently comes in four sizes, supporting necks as scrawny as 12 inches and as burly as 32 inches. That's a wide range, but if you intend to buy Voyce for a toy breed, you'll have to wait for i4C Innovations to miniaturize the collar further. The company is targeting the Q4 2015/Q1 2016 time frame for that next step.

Ideally, the Voyce sensor is supposed to settle at the 6 o'clock position below a dog's neck. Whiskey's collar always seems to be pushed off to one side, but I've never seen any evidence of uncollected data. The Voyce team says as long as the sensor housing is sitting between 3 and 9 o'clock, data collection should be fine.

As you can see from the photos in this article, the plastic collar picks up scuffs and dirt. Like the basic aesthetics, this doesn't bother me. However, I am bothered by the collar's bright, blinking green LED, which serves as a visual indicator to confirm the band is working. When Whiskey enters the bedroom in the middle of the night, the LED lights up the whole room—and that negatively affects my health and wellness.


Whiskey doesn't show any indication that she's annoyed by the LED or even wearing the collar in the first place, but clearly i4C knows the LED is a friction point for humans. The current LED has an auto-dimming feature for low-light situations, and the company says this will improve even further when Voyce moves to a new LED.

The collar currently comes in four sizes, supporting necks as scrawny as 12 inches and as burly as 32.

Can you put a price on a family member's health?

With new pricing in June, i4C Innovations is dropping the cost of its Voyce hardware to \$200, but is increasing the price of its mandatory membership plans by 50 percent. Granted, \$150 a year is a low recurring cost for a platform with such promising health benefits. Because have you seen a vet bill lately? Still, I have to once again point out that Fitbit, Jawbone, Withings, and other human-activity tracker companies don't charge membership fees.

The collar isn't pretty, but that isn't a deal breaker. The platform doesn't have a mobile app, but one is coming. The band won't fit toy breeds, but a smaller version is on the way. And the blinking green LED is distracting, but i4C is working on a fix.

In sum total: Voyce suffers a number of version 1 problems, but the most serious ones are being addressed. "Casual" pet parents will bristle at the idea of paying membership fees, but "casual" pet parents probably shouldn't care for pets in the first place. Would I buy Voyce if total cost of ownership added up to \$1,000 a year? Probably not. Instead I would lean on my vet to spot trouble signs. But \$350 a year isn't an exorbitant price for all the interesting insights and diagnostic data that Voyce provides. 

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10 things users are
still begging for

By **Mark Hachman**

WINDOWS 10 IS NEARLY BAKED

Although Microsoft isn't yet set to release the "final" version of Windows 10, it's nearing the end. Microsoft has said it's moved most of its development to polishing Windows 10, squashing bugs, and tweaking the way it looks and feels.

Throughout the process, however, Microsoft has encouraged users and testers within its Insider program to solicit ideas and feedback on Windows 10. The Windows UserVoice forums are stuffed with hundreds of feature requests, some with tens of thousands of votes.

Not all will make it to the RTM version of Windows 10 due July 29. But there's still hope. Microsoft will continue the Insider program even after Windows 10 ships, and will continue to add updates and new features through Windows 10's lifespan.

Windows 10 looks very different than when it was first announced, and what users want has evolved, too. So what are the features users still yearn for most? We'll show you. But boy, the first one looks doubtful.



1.

Iranians want access to the Windows Store

Right now, Microsoft has blocked Iran from accessing the Windows Store, due to a long-standing trade embargo against the country by the United States government.

What Microsoft apparently hasn't realized, however, is that the embargo was partially lifted in 2013. Iranian General License D allows some hardware, software, and services to be sold to customers in Iran. Google led the way by opening its Google Play Store (but only free apps) to Iranian consumers that year.

The top request by Windows 10 users, with over 55,000 votes, is for Microsoft to lift its own embargo and provide access to the Windows Store for Iranian customers. "Why are u so selfish, we have right like other people in the world, we do nothing wrong. We're just trapped in a wrong place. Open the store please, we need to," Souroush Askari wrote.

It's notable that Microsoft has already made concessions to Middle Eastern users. In October, the addition of a Persian-language calendar was one of the top feature requests for Windows 10. It has since been added.

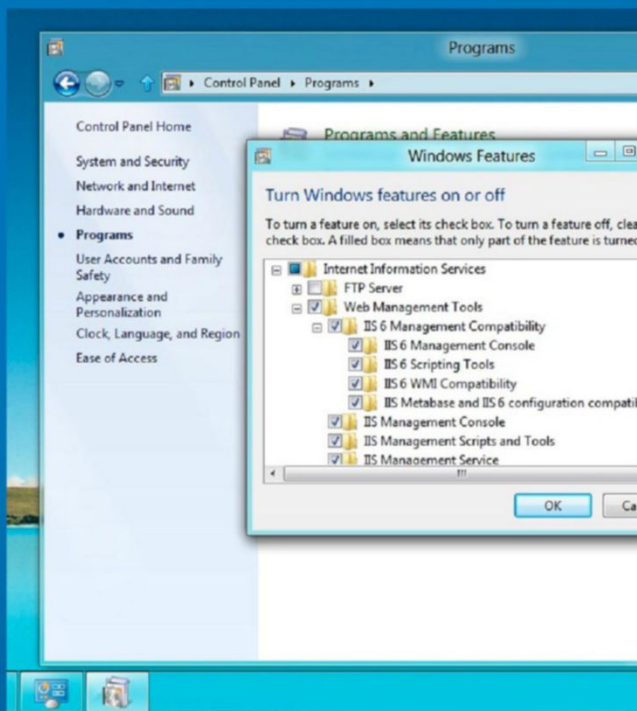
2.

Aero Glass forever!

In October, fans of the Windows Vista “Aero Glass” scheme had managed to drum up only 1,800 votes or so. Today, the Aero Glass movement is marching boldly forward, 49,500 votes and counting at press time.

“Microsoft is forgetting that over 250 million (75 million of them on Steam alone) are using Gaming PCs capable of driving more GPU and RAM hungry OS shells like Aero Glass,” the original submitter states. “Please allow us to have the choice to use the Aero Glass you so kindly provided in Windows 8 Developer preview and took from us in RTM.”

Well, there are solutions. Glass8.eu has released Aero Glass skins for most public builds of Windows 10. Microsoft hasn’t forgotten its very vocal Aero Glass fan base, either: Windows 10 Build 10074 adds the “frosted glass” look that Aero Glass uses in some of the builds.





Hi, I'm Cortana

3.

Add Persian (Farsi) language support to Cortana

One phrase would make over 37,500 commenters happy:

“هیتس نه مالس Cortana,” or “Hi, I’m Cortana” in Farsi. Like the thousands of users who pushed Microsoft to add support for

Persian-language calendars, so have Microsoft’s users begged for Microsoft’s digital assistant to speak the language spoken by about 110 million people.

While a Persian-language calendar might not be that difficult to implement, we’d have to imagine that inputting the proper phonemes into Cortana, training them, and then pushing them out to users would be a far greater challenge. It’s possible that Cortana might eventually speak Persian, but most likely well after the RTM release.

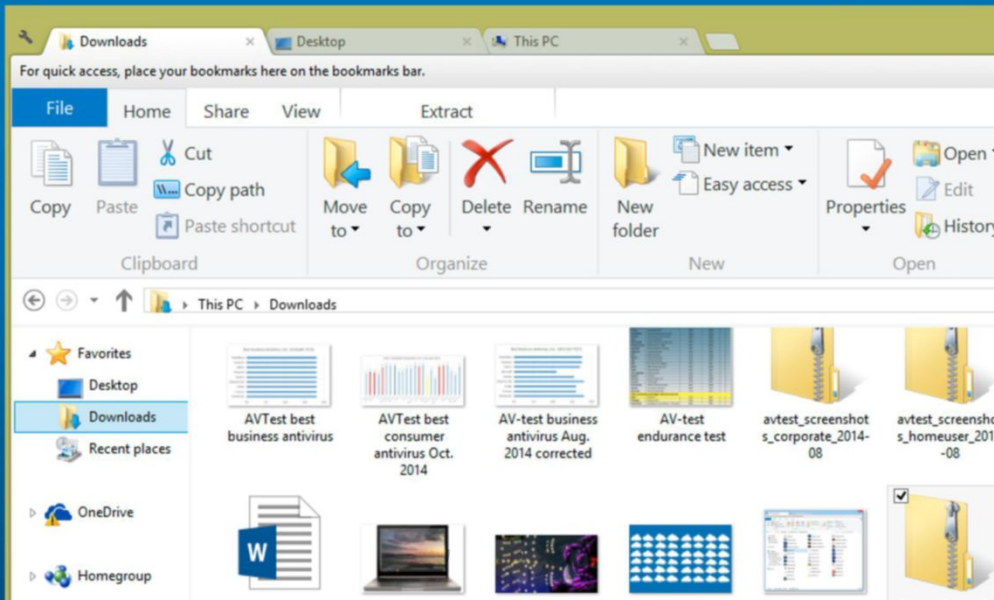
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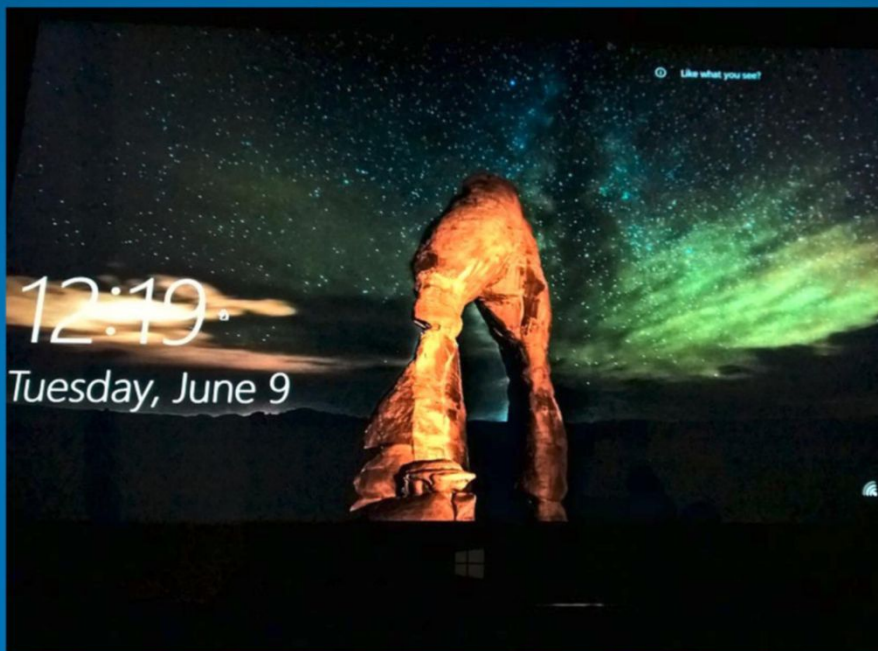
Tabbed windows in Windows Explorer/File Explorer

The ability to add multiple tabs to a Web browser is a staple of Internet Explorer and the like—so why isn't it part of Windows' File Explorer, as well? It's a reasonable statement, and more than 29,200 people agree with it.

"Every other OS has this feature and Windows is severely lagging behind," according to the submission.

Note that this feature is already available for Windows 8, via plug-ins like Ejie Technology's Clover2. And just this week, Microsoft's Matthias Baer said that Microsoft is building a feature called "Quick Access" into Windows 10. It's not the tabbed windows that users want, but it does the next best thing: It places a user-configurable list of files and folders in a reserved area of the window that users can pin and unpin.





5.

Customize the Windows 10 login screen

Over 27,000 people have requested that users be able to put their own wallpaper image on the lock screen, just as Windows 7 used to do.

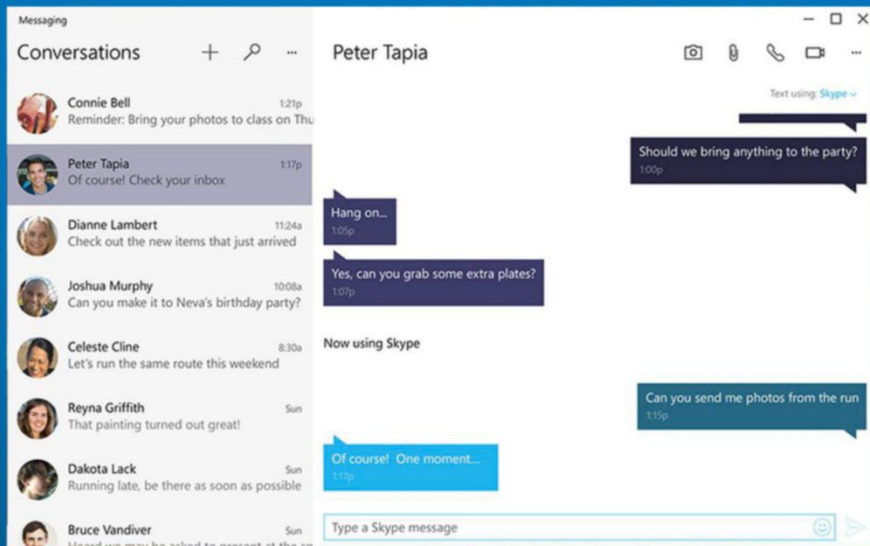
Personally, I see no need for this. I'm sort of a nature photography junkie, and Microsoft Bing scratches my itch daily with gorgeous outdoor shots. Even better, Microsoft has recently begun adding them to the Windows 10 lock screen. So while I certainly understand why users would want to be greeted by an image of their beloved Dachshund or Mr. Fluffles the cat, I can't help but hope that Microsoft continues its trend of reminding us what's outside our office windows.

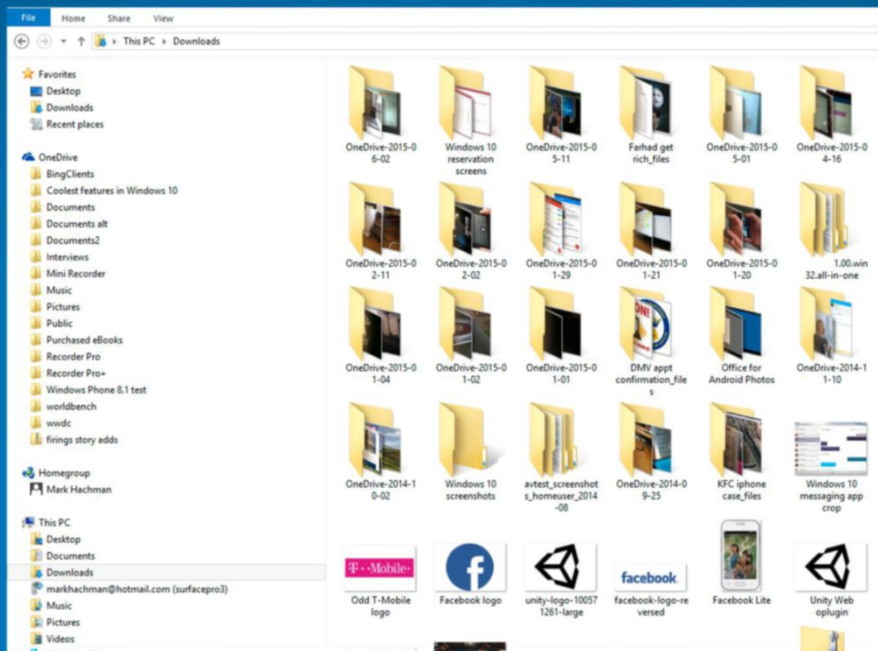
6.

Mondo Messaging—including calls

In January, Microsoft wowed us all with a unified, universal Messages app that seemed to include everything: Skype messages, SMS, possibly Facebook messages, and more. It was emblematic of the unified vision that Microsoft had for Windows 10, roaming across devices as its services roamed across platforms. Unfortunately, it's reportedly now in limbo.

Undaunted, about 27,000 people hope that Windows 10 will include a revamped app that will “send/receive calls, texts, Facebook Messages, play/save voicemails on desktop within one messaging conversation.” It doesn’t seem likely that you’d be able to place calls from a desktop PC (Skype excepted) but you might from a connected phone. It’s all fantasy for the moment, though, apparently.





7.

Fix the annoying thumbnail cache deletion bug!

Almost every time you open a folder with a huge number of images in it—my own Downloads folder is such an example—Windows 8 insists on reindexing virtually all of it.

It takes time and can be a huge annoyance. And nearly 23,000 people agree.

The bug is still present in Windows 10. But phew! It's officially under review. "The product development team has added new diagnostic code to detect and debug as they continue to look at the issue," Microsoft writes. Thank goodness Microsoft is in bug-squashing mode.

8.

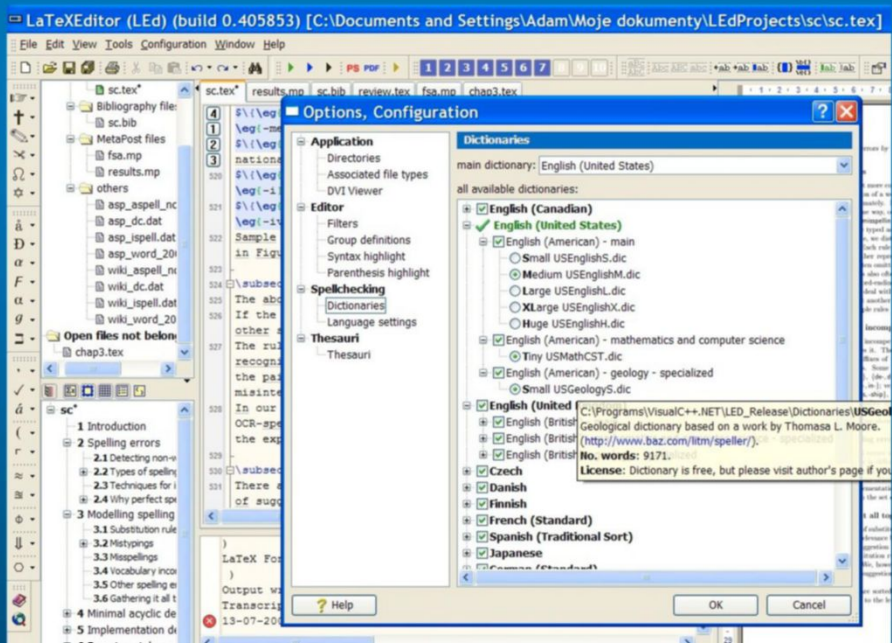
Include LaTeX editor in Microsoft Office

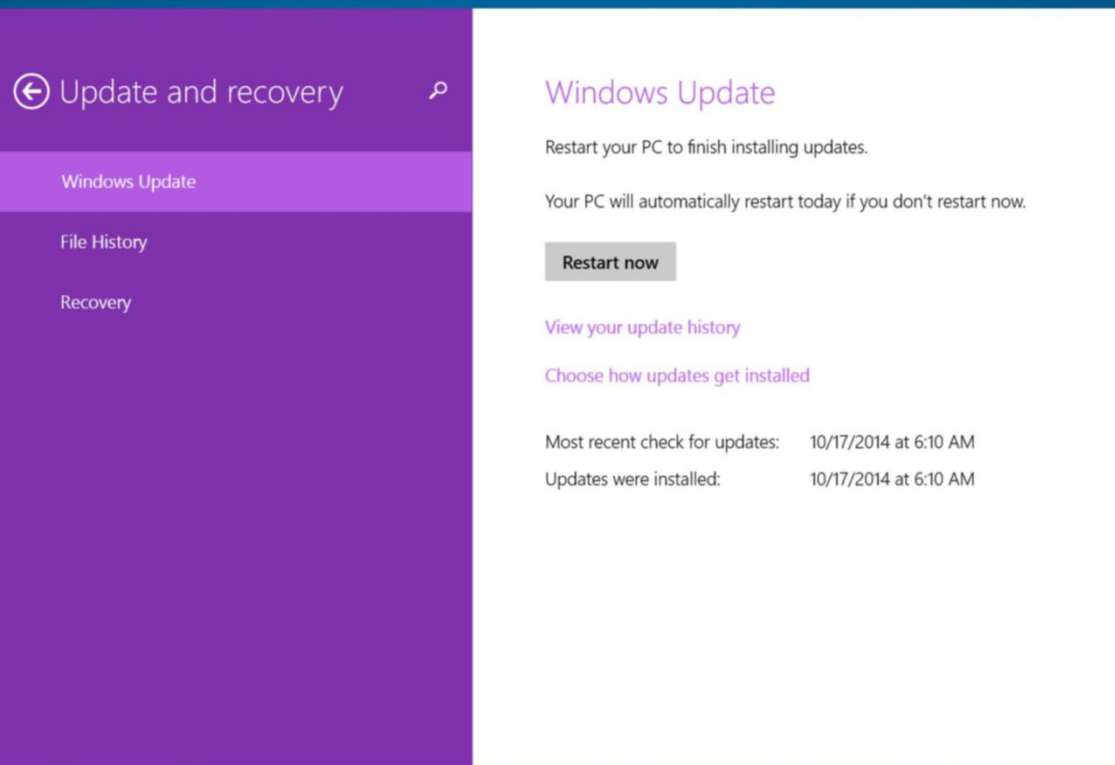
Even though Microsoft's UserVoice section covers Windows 10, suggestions for related apps sometimes sneak in. About 18,000 people want support for a modern LaTeX editor in

Microsoft Office.

"In 2009, LaTeX was used to typeset 96.9% of publications in mathematics, 89.1% of publications in statistics, 79% of publications in physics, and its use is widespread in computer sciences, engineering, geosciences, astronomy, ecology, chemistry, biology, medicine, psychology, and political and social sciences," the submission claims. It's used for all sorts of textbooks as well.

LaTeX is public software, although its license includes an odd provision: Modified files must be clearly marked as such to distinguish themselves from the original. That might possibly break Microsoft's file format. (The original license prevented any modified file from using the filename of the original file.)





9.

Windows Update: a one-stop shop for drivers?

Why should users have to download software to update their mice? And their scanners? And their graphics cards? And... the list goes on. About 17,000 users want Windows to be their Walmart of drivers, supplying everything they could ever hope to need. And you know, we'd agree with them.

10.

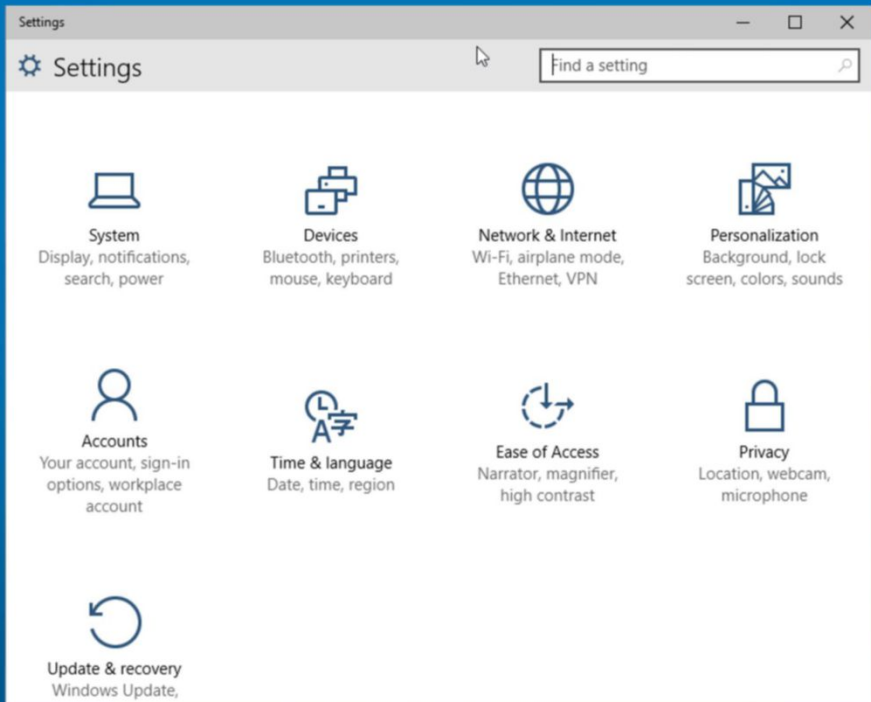
Merge the Settings, Control Panel

Forcing users to find information in one location may be constricting for some, and comforting for others. About 17,600 people fall into the latter camp, arguing the PC

Settings menu makes the Control Panel redundant, or vice versa.

And it does, really, especially because the Control Panel can sometimes add more granular options that Settings doesn't supply. Still, both Settings and the Control Panel seem to be pretty entrenched inside the Windows operating system. We'll see how it all plays out.

So what features would you like to see added to (or subtracted from) Windows 10?





— THE ESSENTIAL GUIDE TO — **Powerline Ethernet Adapters** — (including 10 hands-on reviews) —

BY YARDENA ARAR

W

hen I tested powerline networking products six months ago, ZyXel's PLA5405 adapter kit—the first to be based on the HomePlug AV2 MIMO standard—was the fastest by a wide margin. Fast-forward to now: D-Link and Netgear are offering new products based on that standard, and Comtrend has shipped a powerline adapter based on the competing, but less familiar, G.hn standard.

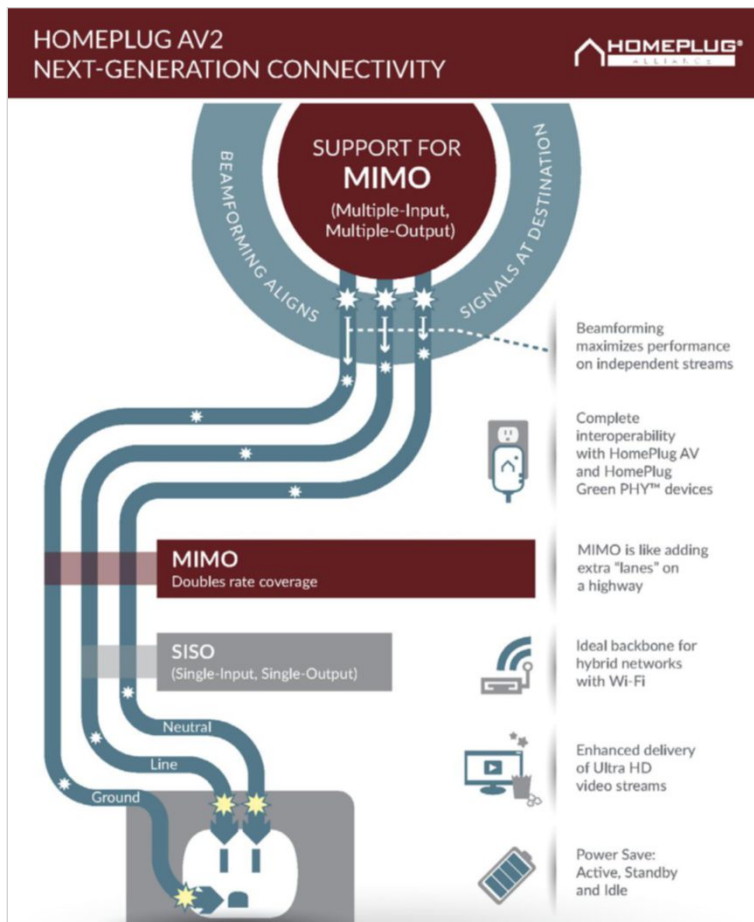
HomePlug and G.hn both define a method for carrying data—including audio and video—over standard electrical cables. This enables you to use existing wires in your home as a data network. HomePlug is based on the IEEE 1901 and IEEE 1905.1 standards, while G.hn is based on the competing ITU G.9960 standard. In addition to using power lines to form a network, G.hn also supports using telephone wiring and coaxial cables.

G.hn and the latest version of HomePlug—HomePlug AV2 MIMO—use a variant of the multiple input/multiple output technology you'll find in 802.11n and 802.11ac network devices. Using MIMO, a powerline device will utilize all three wires in an electrical cable, transmitting data on any two pairs: Line/Neutral, Line/Ground, Neutral/Ground, and so on to achieve theoretical TCP throughput of up to 1.2Mbps. Earlier HomePlug devices transmit



using only the Line and Neutral wires; HomePlug AV delivered maximum throughput of 600Mbps.

You should be aware that real-world performance is considerably lower in both cases. Also, your home must have three-prong outlets to get the full benefit from MIMO. HomePlug AV2 MIMO adapters will work with two-prong outlets, but they'll fall back to SISO mode (single input/single output) and deliver less throughput.





No mixing: HomePlug and G.hn are incompatible

Powerline networking can be faster and more reliable than Wi-Fi when you need to serve client devices that are behind very thick walls—particularly concrete or masonry—or that are multiple stories away from your router. But the two powerline standards discussed here are not interoperable, so choose one or the other.

To create a powerline network, plug one adapter in an AC outlet near your router and connect it to your router using an ethernet cable. Plug other adapters into AC outlets near the devices you want to add to the network, and then connect those devices to the adapters using ethernet cables. Don't plug the adapters into outlet strips or surge protectors, as those devices might consider the data packets traveling over the wire to be noise and filter them out.

My testing also suggested that powerline performance varies widely depending on the location of the adapters. Each product was much slower when the adapter connected to the router was further away from the adapter attached to the client, although their

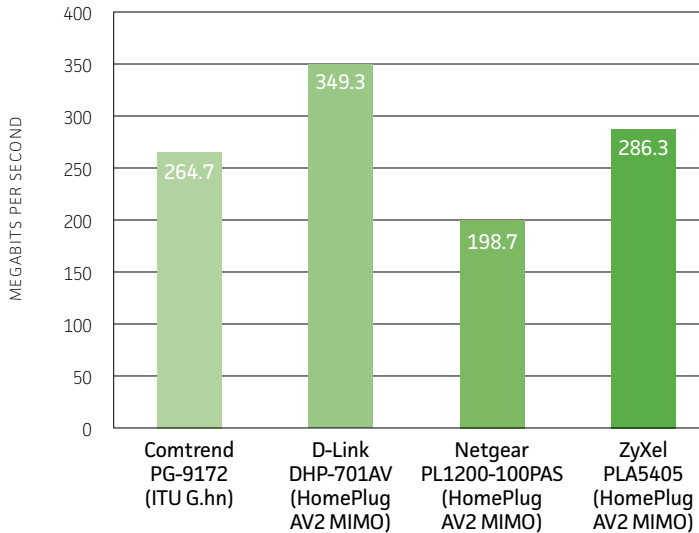
performance relative to each other didn't change.

While the HomePlug Alliance certifies powerline products bearing the HomePlug brand as interoperable, that doesn't mean you'll get optimal performance from a network formed by a mix of HomePlug AV2 MIMO brands. When I connected D-Link's DHP-701AV adapter to my router and connected the client computer to Netgear's PL1200-100PAS, I saw significantly degraded performance compared to using the same brand at both ends. Interestingly enough, I saw much better

Make/Model/Standard	Average TCP throughput	Street price (Amazon)*	Street price (Newegg)*
Comtrend PG-9172 ITU G.hn	264.7	\$78	\$75
D-Link DHP-701AV HomePlug AV2 MIMO	349.3	\$157	\$157
Netgear PL1200-100PAS HomePlug AV2 MIMO	198.7	\$80	\$100
ZyXEL PLA5405KIT HomePlug AV2 MIMP	286.3	\$82	\$100
D-Link DHP-601AV HomePlug AV2	66.6	\$80	\$91
Linksys PLEK500 HomePlug AV2	67.2	\$75	\$75
Netgear XAVB5201 HomePlug AV enhanced	61.8	\$56	\$60
TP-Link TL-PA6010KIT	78.3	\$72	\$72
Trendnet TPL-408E2K HomePlug AV enhanced	65.6	\$59	\$72
Trendnet TPL-420E2k HomePlug AV2 MIMO	94.0	\$80	\$110
ZyXEL PLA5405KIT HomePlug AV2 MIMO	115.0	\$82	\$82
*Street prices as of June 11, 2015			

Four of the adapters were benchmarked in one location and the rest were tested in another. The ZyXel PLA5405 was evaluated in both because it was the top performer from the previous roundup.

Gigabit Powerline Ethernet Adapter Performance



performance in the reverse scenario: The Netgear connected to the router and the D-Link on the client end. Bottom line: No matter which powerline product you choose, stick with one standard and one brand.

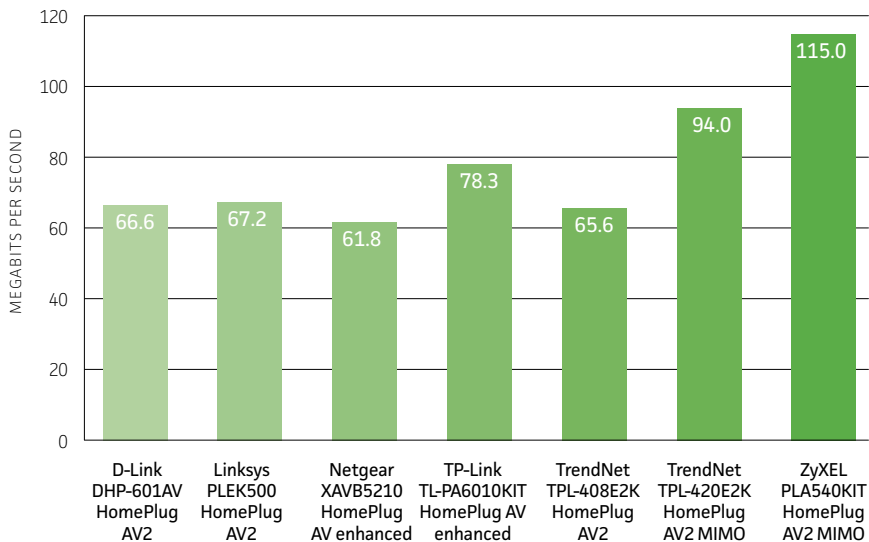
You can mix powerline and Wi-Fi devices, though, and most people do. You can also buy powerline-based Wi-Fi range extenders that create local wireless access points in rooms where your Wi-Fi signal can't reach. Powerline is a fantastic solution when Wi-Fi alone doesn't cut it, but Wi-Fi is much more convenient if for no other reason than Wi-Fi adapters are built into nearly every device (smartphones, laptops, tablets, media streamers). Plus, there's the whole "no wires" thing; heck, even newer set-top boxes and DVRs have gone wireless.

How I tested

To check performance on the kits we tested, I connected one adapter to a free LAN port on my router in one room, and a Windows 8 notebook to another free LAN port (this one functioned as a server). I then connected a second Windows 8 notebook to the second adapter plugged into an outlet in another room. I measured TCP throughput using JPerf software installed on both notebooks.

I then streamed a high-def movie from the downstairs (server) notebook to the upstairs notebook using iTunes' home sharing feature. While this test is anecdotal at best, it confirmed that all of the kits we tested are capable of streaming high-def video, one of the main reasons for using a wired network.

HomePlug powerline Ethernet adapter performance



So which powerline device is fastest?

Two sets of performance graphs accompany this story. The first covers three HomePlug AV2 MIMO adapters and one adapter based on the G.hn standard that were tested in June 2015. The second chart reports the performance of adapters that were tested in January 2015: three HomePlug AV2 adapters, two HomePlug AV2 enhanced adapters, and two HomePlug AV2 MIMO adapters.

I didn't combine the two graphs into one because the benchmarks were obtained at different homes. As you can see from the performance of the one adapter—the ZyXel PLA5405—that was tested in both places, wiring quality can have a big impact on powerline performance. The performance should be relative, however; if one device is considerably faster or slower than another using one home's wiring, it should perform similarly when using another home's wiring.

D-Link's DHP-701AV finished first in this roundup, but D-Link makes you pay for that performance. Its two-adapter kit was the most expensive by a very wide margin. ZyXel's PLA5405 came in a respectable second, and it carries a much lower price tag. Netgear's adapters (I tested both the PL1200 and the PLP1200, which has a passthrough electrical port so you don't lose the use of the outlet it's plugged into) were much slower than everything else I tested, which means they have a very poor price:performance ratio.

As for the standards battle, it wouldn't be fair to declare a winner based on the performance of the only G.hn adapter I've tested; namely, Comtrend's PG-9172. Having said that, the PG-9172 is less expensive than all the other adapters, and it was faster than Netgear's PLP1200. On the other hand, the two remaining HomePlug AV MIMO adapters—D-Link's DHP-701AV and ZyXel's PLA5405—were faster still.

You can read the individual reviews for details as to how each powerline adapter performed.

Comtrend PG-9172 review:

The first powerline adapter we've tested that's based on the G.hn standard

The Comtrend PG-9172 demonstrates the G.hn standard's ability to deliver decent powerline performance at a good price, but it's incompatible with the many HomePlug AV2 MIMO competitors, and it's not as...

The companies backing G.hn—the ITU standard for home networks that rely on a home's existing powerline, telephone line, and coaxial cable—have for years been touting the technology's speed, versatility, and general suitability for high-bandwidth applications; particularly streaming media and online games. Up to now, we haven't been able to test any of those claims since there have been no consumer products based on the standard.

There is now, but Comtrend's PG-9172 Powerline ethernet Adapter is leading the G.hn charge in underwhelming fashion. While performing respectably in our Jperf tests, their average throughput of 265Mbps was well below the nearly 350 Mbps that D-Link's DHP-701AV delivered using proprietary enhancements to the rival HomePlug AV2 MIMO standard. The PG-9172 also was slower than ZyXel's PLA 5405. But it did manage to beat the stuffing out of Netgear's PL1200. The ZyXel and the Netgear are also based on the HomePlug AV2 MIMO standard.



The first G.hn powerline adapter we've tested got beat by two out of three powerline adapters based on the HomePlug AV2 MIMO standard.

On the bright side, the Comtrend PG-9172 is one of the most compact high-performance powerline adapters we've seen. These adapters require three-pronged adapters to deliver their best performance, because they make use of an electrical cable's ground wire to achieve maximum speed. LEDs indicate connections to power, a powerline network, and ethernet.

Comtrend PG-9172



AT A GLANCE:

The Comtrend PG-9172 demonstrates the G.hn standard's ability to deliver decent powerline performance at a good price, but it's incompatible with the many HomePlug AV2 MIMO competitors, and it's not as fast as the best of them.

PROS:

- Respectable performance
- Compact form factor
- Attractive price

CONS:

- It's not the fastest powerline adapter
- Incompatible with more common HomePlug powerline adapters

PRICE: \$78

You can buy a pair of PG-9172s in kit form for less than \$80, which is almost half the cost of a pair of D-Link's DHP-70, about \$20 less than the ZyXel PLA5405KIT, and on par with the slower Netgear PL1200-100PAS. That's a pretty good deal viewed from the perspective of price/performance ratio. On the other hand, the G.hn standard has not yet gained significant traction in the home-networking market.

Powerline networking adapter table

Comtrend's PG-9172, based on the G.hn standard, is more competitive on price than it is performance.

We've also yet to see real-world G.hn products based on the other types of wiring the standard supports: telephone wire and coax. You can already use coax cable (via the MoCA standard) to supplement your network, so it just doesn't seem like G.hn is adding all that much.



D-Link DHP-701AV review:

This HomePlug AV2 MIMO powerline adapter wins the speed prize

If you seek the fastest powerline performance currently available, look no further than the D-Link Powerline AV2 2000 (model DHP-701AV). In my tests using the Jperf network performance tool, throughput averaged almost 350 megabits per second—more than 50 Mbps higher than its closest competitor, the ZyXel HD Powerline 1200 PLA5405.

Powerline performance varies widely depending on how a home is wired and the location of a networked device relative to the router, but relative performance never varied in my tests: D-Link's adapter was always the speediest.

D-Link applied some proprietary tweaks to the HomePlug AV2 MIMO standard to achieve its excellent performance.

There's a reason for the superior performance: D-Link DHP-701AV adapters use more of the bandwidth on electrical circuits (2- to 86MHz) than standard HomePlug AV2 MIMO products, which top out at about 68mhz. That's why D-Link pegs the DHP-701AV's theoretical performance at 2000 Mbps as opposed to the 1200 mbps claimed by standard HomePlug AV2 MIMO products.

Of course, you'll only enjoy the performance advantage between devices equipped with D-Link AV2 MIMO adapters (but in my tests, all powerline products performed best when paired with products from the same vendor). Performance degrades dramatically on a network with AV2 MIMO adapters from different vendors.

D-Link DHP-701AV



AT A GLANCE:

D-Link stomps the competition with the fastest powerline networking products on the market.

PROS:

- Fastest powerline network performance available thanks to proprietary enhancements to HomePlug AV2 MIMO technology

CONS:

- Higher-than average MSRP; much-higher-than-average street price
- Proprietary enhancements to HomePlug AV2 MIMO technology

PRICE: \$157

Powerline networking adapter table

There was no faster powerline adapter available on the day we published this review, and non more expensive than the D-Link DHP-701AV.

D-Link DHP-701AV adapters are large and chunky compared with most competitors; good luck trying to use a second wall outlet for something else (and there is no pass-through outlet). Also, as word has gotten out about the product's stellar performance, street prices for a two-adapter starter kit are much higher than D-Link's \$130 MSRP—and that's already higher than most other HomePlug AV2 MIMO starter kits. Supply and demand, doncha know. (D-Link expects prices to come down as inventories are replenished.)



D-Link DHP-601AV HomePlug Ethernet Adapter review:

This HomePlug AV2 MIMO powerline adapter wins the speed prize

D-Link's first HomePlug AV2 adapters are somewhat large—about the size of a deck of cards—but its two prongs are placed so that when plugged into an outlet, the second outlet should be available to standard-sized plugs.

LEDs glow to indicate whether the adapter is receiving power, whether it's connected to a power-line network, and whether an Ethernet device is connected. The adapters have both pushbutton and password security setup options.

D-Link DHP-601AV PowerLine AV2 600 Gigabit Starter Kit

★★★★★

AT A GLANCE:

There's nothing particularly remarkable about D-Link's DHP-601AV PowerLine AV2 600 adapters, but they perform well and are priced right.

PROS:

- Good price/performance ratio
- Stubby bundled Ethernet cables

CONS:

- Chubby form factor

PRICE: \$81

The D-Link DHP-601AV is no faster than most of its competitors, but it has a lower street price and it doesn't have a third prong.

In my tests, this D-Link's performance was on par with other basic HomePlug AV2 kits, moving data at speeds at roughly 65Mbps to 69Mbps. Like others in this review, it had no difficulty streaming high-def video.

I wish D-Link had provided somewhat longer Ethernet cables. The ones in the box were among the shortest of this roundup, measuring about 40 inches long, which was barely enough to connect a notebook on a desk to an outlet behind it. But the D-Link DHP-601AV is one of the least-expensive HomePlug AV2 starter kits available, making it a good option for budget-sensitive buyers (Ethernet cables are nothing if not cheap).



Linksys PLEK500 Powerline Networking review:

Pricey for its performance

The adapters in the Linksys AV2 networking kit were the only ones in their class to be outfitted with three prongs (the Zyxel AV2 MIMO adapters do, too, but they're MIMO adapters). Avoid these if your home doesn't have grounded wiring, because you won't be able to plug them in. What's more, their chunky form factor (they have a smaller footprint than D-Link's DHP-601AV, but the Linksys are thicker) makes it difficult to use the second outlet in a duplex.

The Linksys' performance was almost identical to that of D-Link's AV2 adapters, between 65Mbps and 70Mbps, with good-quality video streaming. And like D-Link's, the Linksys adapters have LEDs to show connections to power, a power-line network, and an Ethernet device, plus passwords and push-button security options.

Linksys does provide a pair of five-foot Ethernet cables (D-Link's were much shorter, but other vendors use longer cables) and an

Linksys PLEK500 Powerline 500 Wired Network Expansion Kit



AT A GLANCE:

It's unclear why these Linksys adapters need a ground plug, since they don't support MIMO over power-line. And their chunky form factor makes it difficult to make use of the second wall outlet.

PROS:

- 5-foot Ethernet cables in the box

CONS:

- Three-prong plugs, even though these aren't MIMO devices
- Chunky form factor

PRICE: \$88

installation CD (which many people might not be able to use—my notebooks don't have optical drives).

Linksys must think these extras are precious, or maybe it just has an outsized opinion of its own brand: The kit's \$130 MSRP is half again as much as that of the D-Link kit, and it's higher than any of the HomePlug AV contenders. The price difference narrows on the street, but it's still tough to justify the premium if longer cables and a CD are the only significant advantages.



Netgear Powerline 1200 (PL1200-100PAS) review:

Disappointing MIMO performance

When you shop for HomePlug AV2 MIMO powerline adapter, you'll find that the street price of Netgear's Powerline 1200 (PL1200-100PAS) is about 49 percent lower than that of the king-of-the-hill D-Link DHP-701AV. But take a look at our benchmark charts and you'll see that the Netgear is also about 43 percent slower than the D-Link. And 30 percent slower than the ZyXel PLA5405. And 25 percent slower than the G.hn-based Comtrend PG-9172.

It seems the street has yet to figure this out, as Netgear's kit costs more at retail than Comtrend's, and only slightly less than ZyXel's.

The street price of Netgear's PL1200 HomePlug AV2 MIMO powerline adapter is out of line with its performance.

Netgear PL1200-100PAS



AT A GLANCE:

The Netgear PL1200-100PAS is speedy enough for most high-bandwidth tasks, but it's significantly slower than competing HomePlug AV2 MIMO adapters that don't cost much more.

PROS:

- Relatively inexpensive
- Faster than powerline adapters based on older HomePlug standards
- Available sister product offers an electrical pass-through

CONS:

- Chunky form factor
- Significantly slower than the competition
- Poor price/performance ratio

PRICE: \$80

Now the D-Link DHP-701AV achieves its high speed via proprietary enhancements, but the ZyXel PLA5405 is pretty stock. As for the Comtrend PG-9172, we're recommending consumers wait for additional G.hn products to ship before jumping on that particular bandwagon.

The physical size of Netgear's adapter is another reason to leave it on the shelf, too; it's tall enough to block the top tap in your wall outlet. You could spend an additional \$10 per pair to buy the Netgear Powerline 1200 + Extra Outlet (Netgear model PLP1200-100PAS), which provides a pass-through electrical outlet. That's a feature none of Netgear's competitors currently offer, surprisingly enough, but the extra cost won't deliver any extra performance.



Netgear XAVB5201 HomePlug Ethernet Adapter review:

Squeezing better performance from an old standard

Netgear's current power-line offering is based on the HomePlug AV spec with enhancements that bring theoretical speeds up to 500Mbps (hence the product name). When I asked why the company hadn't introduced an AV2 product, the answer was that Netgear considered these adapters competitive with other vendors' first-generation AV2 gear.

Our tests showed this claim to be only slightly exaggerated in terms of performance: TCP throughput was in the low 60Mbps range, or about 5Mbps to 6Mbps slower than the speeds of the first-generation AV2 products in this roundup. That's generally in line with what HomePlug Powerline Alliance officials told us to expect in terms

of performance differences between enhanced HomePlug AV and basic AV2.

The performance of Netgear's XAVB5201 power-line Ethernet adapter is very good, considering its based on the older HomePlug AV standard. On the other hand, it's based on the older HomePlug AV standard.

The adapters in the Netgear XAVB5201 starter kit are somewhat smaller than the others in this roundup, which makes it easier to use the second receptacle in the typical wall outlet. Netgear provides long (about 6.5 feet) ethernet cables, pushbutton and password security options, and the typical three LED lights to indicate power, power-line network, and ethernet connections.

Netgear XAVB5201 Powerline 500Mbps Adapter

★★★★★

PROS:

- Fast performance
- Small form factor

CONS:

- Proprietary enhancements

PRICE: \$90

While its \$90 MSRP seemed a bit high for older-generation technology that falls slightly short of newer products in terms of performance, street prices are falling fast (no doubt helped by Netgear's CES product announcements).

Given that the performance difference may not matter for most people, the XAVB5201 could be an attractive buy if its price falls below that of the AV2 competition—and if you're not planning on adding additional adapters from other vendors that might not support the proprietary technology that makes this product so competitive.



TP-Link TL-PA6010KIT HomePlug Adapter review:

Very fast for HomePlug AV

Whatever TP-Link did to soup up the HomePlug AV adapters in its AV600 Gigabit Powerline Adapter Starter Kit, it definitely worked. In my tests, it racked up TCP throughput speeds in the high 70Mbps range, a good 10Mbps faster than the other enhanced HomePlug AV and basic HomePlug AV2 products in this roundup.

TP-Link's adapters have a small matchbox-sized footprint, but are thicker than most. Still, I had no problem adding a second plug to the wall outlet with the TP-Link adapter installed. Like the other adapters in this roundup, it has lights to show power, power-line, and ethernet connections; and it has both password and pushbutton security setup options. The provided ethernet cables are a generous 6.5 feet long.

The \$95 MSRP is admittedly pricey for older-generation technology, but street prices are lower, and if you don't plan to add

TP-Link TL-PA6010KIT AV600 Gigabit Powerline Adapter Starter Kit



AT A GLANCE:

TP-Link's TL-PA6010KIT costs a bit more than the competition, but it delivers more performance, too.

PROS:

- Very fast
- 6.5-foot Ethernet cables

CONS:

- Proprietary enhancements
- Pricey (considering it's not MIMO)

PRICE: \$80

additional adapters from other vendors (which probably won't deliver the same speed), the stellar performance should seal the deal for most users.



Trendnet TPL-408E2K HomePlug Adapter review:

Being skinny didn't make this adapter any slower

Trendnet's HomePlug AV2 kit (mysteriously labeled as delivering 500Mbps when most AV2 products are rated at 600Mbps) sports a mid-sized footprint (smaller than a deck of cards but larger than a matchbox) and a slimmer profile than other products in this roundup. It ships with two five-foot ethernet cables, but its features are otherwise similar to the rest of the field: LEDs show power, power-line network, and ethernet connections; and there's password and push-button security options and a gigabit ethernet port.

Trendnet's TPL-4082E2K was the thinnest HomePlug adapter we tested, but that doesn't seem to have hobbled its performance.

Performance was more or less on par with that of the other first-generation HomePlug AV2 products we tested (the D-Link DHP-601AV

Trendnet TPL-408E2K Powerline 500 AV2 Adapter Kit

★★★★★

AT A GLANCE:

Trendnet makes surprisingly modest claims for its HomePlug AV2 adapter considering it delivers one of the better values in this space.

PROS:

- Slim profile
- Attractive price/performance ratio

CONS:

- Proprietary enhancements
- Pricey (considering it's not MIMO)

PRICE: \$67

and the Linksys PLEK500), with TCP throughput in the high 60 Mbps range. The kit's list price fell between that of the D-Link and Netgear, but street prices were considerably lower; in fact, this was one of the lowest-priced power-line adapter kits in its performance tier that we saw on Amazon.

That makes the Trendnet kit a worthy option for people who want to keep their expansion options open without spending a lot of money: You should be able to add entry-level AV2 adapters from any vendor without worrying about performance issues due to incompatible proprietary enhancements.



Trendnet TPL-420E2K Powerline Adapter Kit review:

Slower and more expensive isn't a good combo

When we surveyed the power-line network landscape in January , only one product based on the fastest version of the HomePlug AV2 standard was available. Promising nominal speeds up to 1200 megabits per second, the ZyXel PLA5405KIT was faster than anything we tested, but it was also the most expensive kit in the roundup. Now Trendnet joins the fray with its Powerline 1200 AV2 Adapter Kit (Trendnet's model number TPL-420E2K). Trendnet's offering falls short of Zyxel's in terms of performance, and its current street price is \$17 higher.

The Trendnet TPL-420E2K delivered TCP throughput of 94Mbps, which is somewhat slower than the 115Mbps average of the Zyxel, but still faster than the products without the optional enhancements. Either product is worth considering for back-up devices or entertainment centers that need high-bandwidth for streaming media, something Wi-Fi can't always provide.

Like other HomePlug AV2 kits, the Trendnet TPL-420E2K ships with two small boxy adapters that plug directly into wall outlets. Each adapter

has a gigabit ethernet port, and the kit includes two five-foot ethernet cables as well. The size of the adapters might block the second outlet (especially if you need to plug in another wall wart).

To create the power-line network using an existing Wi-Fi router (the most likely scenario for most people), you plug one of the adapters into a free wall outlet and run a cable from its ethernet port to a free LAN port on the router. Now you can plug in the second adapter to a free outlet near a device you wish to add to your network and run the second cable from the adapter to the device's ethernet port.

Use a wall outlet rather than, say, a power strip, which likely has surge-suppression technology that can degrade the ethernet signal.

The technology is plug-and-play, meaning it requires no additional setup to work. Should you wish to add another HomePlug device, however, you'll need to sync it to the network, typically by pressing buttons on both the new and one of the existing adapters (or by typing the adapter's unique identifier into a software utility that most vendors provide). Data is encrypted using 128-bit AES.

For those who don't follow the minutiae of HomePlug AV standards for networks that use existing electrical wiring, HomePlug AV2 (the third-generation HomePlug spec) includes both mandatory and optional components. The first wave of HomePlug AV2 products were based on the mandatory components only, which promised nominal network speeds of up to 600 megabits

Trendnet Powerline 1200 AV2 Adapter Kit (TPL-420E2K)



AT A GLANCE:

The TPL-420E2K is faster than any non-MIMO HomePlug AV2 product we've tested, but it's not faster than ZyXel's PLA5405KIT and it's more expensive.

PROS:

- Much faster than non-MIMO HomePlug AV2 products
- Good choice for locations that Wi-Fi can't reach
- Fast enough to stream HD video

CONS:

- Not the fastest product in its class
- Not the cheapest product in its class
- Large modules might block adjacent plugs

PRICE: \$110

per second and delivered 60 to 70 Mbps in our real-world tests.

The second wave of HomePlug AV2 products utilize the MIMO (multiple input, multiple output) concept first introduced with high-speed Wi-Fi routers. But this requires using all three wires in your home's walls: line, neutral, and ground. If you live in an older home that doesn't have grounded wiring (and three-prong outlets), you won't be able to use this type of power-line adapter.

Even if your home has grounded wiring, you should be aware that the quality of your electrical circuitry can significantly impact the performance of power-line networking devices. In addition to running tests in the same location (my home) that I used for the last group of product tests, I tried out the Trendnet TPL-420E2K in a different home and was unpleasantly surprised to see that speeds in one room were dismal 20–25 Mbps, or even slower than the slowest AV 600 products. Yet in other rooms the speeds equaled those recorded in my own home. A Trendnet spokesperson attributed the poor performance in the one room to incorrect (or possibly crossed) wiring. Sadly, there's no obvious way to determine beforehand whether your network environment suffers from such flaws.

Prices for power-line adapters have dropped significantly since our last roundup, with the street price of ZyXel's PLA5405KIT dropping the most: From \$140 in January to \$93 today. Trendnet's TPL-420E2K carries a list price of \$130; we found it selling online for \$110. It pays to shop around, though. Amazon has great prices on some power-line adapter models, but the Trendnet TPL-420E2K was available there only through one of its third-party merchants—Interlinkseller—which had it listed for sale at \$162, \$32 higher than Trendnet's suggested retail price.

Given that ZyXel's adapter is both faster and less expensive than Trendnet's, the ZyXel PLA5405KIT remains our top choice in high-speed power-line adapters.



ZyXEL PLA5405KIT HomePlug adapter review:

MIMO delivers the goods

In one of those annoying quirks we've seen in networking standards development, all HomePlug AV2 products are not created equal. There are mandatory elements in the spec, and then there are optional ones that, when supported, produce products that are considerably faster than those without those options.

In the case of HomePlug AV2, use of the second wire (ground) in electrical circuits was the optional element that supercharges performance. Products that use the technology, called HomePlug AV2 MIMO, have their own certification program and are just beginning to appear in the market. The ZyXEL AV1200 Powerline MIMO Adapter Starter Kit (PLA5405KIT) is one of the first, and we found that it definitely lived up to the hype.

TCP throughput for ZyXEL's adapters hovered at 115 Mbps—that's about 1.75 times the speed of non-MIMO AV2 products; in fact, it's

close to the performance of a fast 802.11n Wi-Fi network.

Compatibility is a key selling point. If you use one of these adapters to set up the network (i.e. you connect it to a free LAN port on your router), it will deliver those speeds to other AV2-MIMO adapters and it will also communicate with non-MIMO AV2 adapters at their full potential (67 Mbps or so).

Given the product's stellar performance, it's too bad ZyXEL chose to get stingy on the included cables, which (like D-Link's) are only about 40 inches in length. The three-pronged plug also sticks out a bit in the back of the mid-sized adapter, making it difficult to use the second outlet in a typical wall installation.

Otherwise, however, the adapters provide the features we've seen in other current products: LED lights for power, power-line network and ethernet connections, and pushbutton and password security options.

If you routinely transfer large files between computers or storage devices on your home network, you'll appreciate the speed of an AV2 MIMO network. Right now, however, it's a luxury item and is priced accordingly. As more vendors bring AV2-MIMO products to market, prices should start to come down; but for the time being, ZyXEL wins the HomePlug speed race hands down and can command the premium. 🔌

ZyXEL AV1200 Powerline MIMO Adapter Starter Kit (PLA5405KTT)

★★★★★

AT A GLANCE:

ZyXEL is among the first to market with a HomePlug AV2 MIMO product. The premium price tag has shrunk since it was first introduced, but you should shop around as we say a wide disparity in street prices.

PROS:

- Very fast

CONS:

- Stubby Ethernet cables
- Pricey

PRICE: \$82 to 100



*“I want
to be
a bench.
Recycle me.”*



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KEEP AMERICA
BEAUTIFUL



**“ SURE,
AT FIRST I WAS A LITTLE TAKEN ABACK
BY THE WHOLE PEEING STANDING UP THING.
BUT I TAUGHT HIM TO THROW A STICK
AND NOW HANGING OUT WITH HIM
IS THE BEST PART OF MY DAY.”**

**— EINSTEIN
adopted 12-09-10**

**A PERSON
IS THE BEST
THING TO HAPPEN
TO A SHELTER PET**



adopt

theshelterpetproject.org



HERE'S HOW

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HERE'S
HOW

How to create a multiple monitor setup with three or more displays

There are considerations to keep in mind as you move into extreme multi-monitor setups for enhanced productivity and gaming.

BY SARAH JACOBSSON PUREWAL



S **TUDIES HAVE SHOWN** that dual monitors can increase productivity (go.pcworld.com/productivity), but the jury's still out on whether adding even more monitors means even more productivity. That aside, having multiple monitors (and I'm talking three, four, five, or even six) is just... awesome, and something you totally need in your life.

Right now, my main PC has a triple-monitor setup: my main 27-inch central monitor and my two 24-inch side monitors. I use my extra monitors for a number of things, such as comparing spreadsheets side-by-side, writing articles while also doing research, keeping tabs on my social media feeds, and, of course, watching Netflix.

A vertically oriented monitor can save you a lot of scrolling trouble in long documents. If you're a gamer, well, I don't need to sell you on what three-plus monitors can do for games that support multi-monitor setups. You just need to plan ahead. Here's our full guide on setting up multiple monitors—and all the factors you'll need to take into account before you do so.

Check your graphics card(s)

Before you run out and buy a bunch of extra monitors, check to see whether your computer is physically capable of handling all that graphics prowess. The easiest way to do this is to look at the back of your PC: How many graphics ports (DVI, HDMI, DisplayPort, and VGA) do you see?

If you do not have a discrete graphics card, you may only see two video ports—most motherboards come with integrated graphics that can only run dual-monitor setups. If you do have a discrete graphics card, you'll probably see at least three ports, not including the ports on your motherboard.

Tip: While it is possible to set up multiple monitors using ports on

The Nvidia GeForce GTX 650 Ti, which can drive four displays, packs dual DVI ports as well as solitary DisplayPort and HDMI connections.



both your motherboard and your discrete graphics card, you'll see a performance drop and some lag when you move windows between monitors. If you want to do this, you will also need to enter your PC's BIOS (go.pcworld.com/pcbios) and go to *Configuration* → *Video* → *Integrated graphics device* and set it to Always Enable.

Just because you see three or more ports on your discrete graphics card, however, doesn't necessarily mean you can use all of them at the same time. For example, many older Nvidia cards are unable to run more than two monitors on a single card, even if they have more than two ports. The best way to find out whether your graphics card supports multiple monitors is to find the name of your card (*Control Panel* → *Device Manager* → *Display Adapters*) and Google it with the monitor setup you're looking to run (e.g., "Nvidia GTX 770 four monitors").

If your graphics card supports—and has enough ports for—the number of monitors you want to set up, excellent. If not, you may need to purchase an additional graphics card (go.pcworld.com/gcard) to get the multi-monitor support you're looking for.

Alternatively, newer monitors with DisplayPort multi-streaming support (go.pcworld.com/multistream) can be daisy-chained together from a single DisplayPort 1.2 connection on your graphics card, using



additional DisplayPort cables to connect the additional monitors to one another. The various displays don't even need to be the same size or resolution.

Before you buy extra graphics cards, you'll need to make sure that you have enough space in your tower (and open PCIe slots), as well as a power supply unit that can handle the extra strain.

You'll get much better performance with multiple connected graphics cards.

If you buy a graphics card solely for the purpose of having multiple monitors, it's best to get one that's the same as (or, at least in the same product family as) your current graphics card, so you can connect them using SLI (Nvidia) or CrossFire (AMD). SLI and CrossFire setups will help your graphics cards run smoothly, and they'll also boost (go.pcworld.com/boost) your PC's overall graphics performance so you can do fun things like play games in multi-monitor mode without frame rates plummeting. You'll get much better performance with multiple connected graphics cards than you will with multiple non-connected graphics cards. And, while you can technically run Nvidia and AMD cards side-by-side...it's more trouble than it's worth and I don't recommend it.

Monitors, ports, and cables

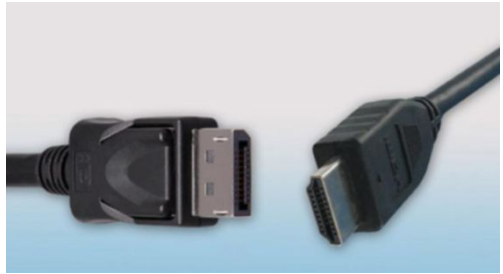
Once you figure out your graphics card situation, it's time for the fun part: obtaining extra monitors. Extra monitors can be had for fairly cheap these days. Assuming you can't finagle a hand-me-down, a 24-inch monitor will run you around \$170, while a decent 27-inch goes for about \$250.

Of course, the perfect monitor for you depends on multiple factors, including the monitors you already have, the size of your desk, and what you're planning on using your extra monitor for.

In my case, I already had two 24-inch monitors, and I wanted a larger monitor as the centerpiece of my setup, so I picked up a 27-inch monitor and placed it between my two 24-inch displays. I'm not using

my multi-monitor setup to play multi-monitor games, so the difference in sizes (and the difference in heights—my 27-inch monitor’s stand holds my 27-incher about one inch higher than my 24-incher) isn’t an issue for me. However, if you’re planning on doing a lot of gaming or watching videos that span multiple monitors, this height difference will make for a not-so-seamless experience.

Before you buy your monitors, you’ll also want to make sure they have input ports that correspond with your PC’s output ports. While you could use conversion cables, such as DVI-to-HDMI or DisplayPort-to-DVI, they can be a hassle. If you have a VGA port on your PC or your monitor, I suggest staying away from it: VGA is an analog connector, which means your picture will be noticeably fuzzier and colors will be less vivid.



A DisplayPort
connector
(left) and an
HDMI cable
(right).

Set up your PC

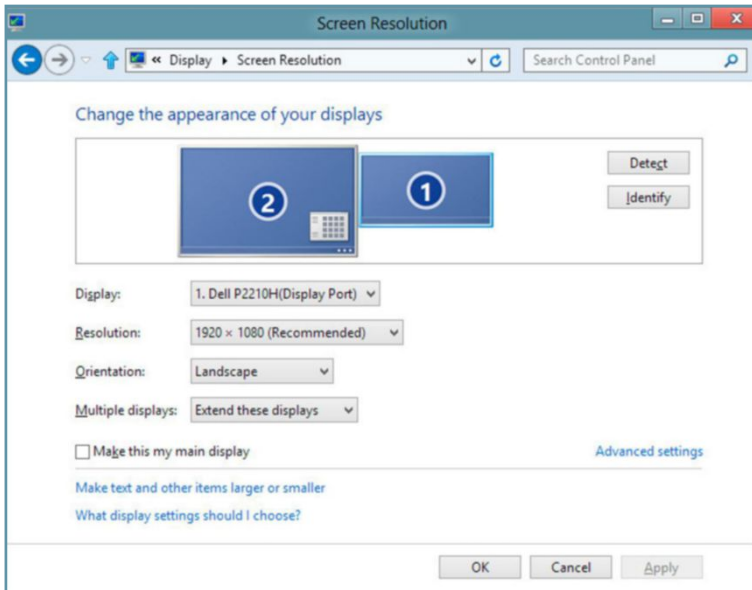
Set up your monitors, plug them in, and turn on your PC. Voilà! A perfectly formed multi-monitor setup! Well, it’s pretty easy, just not that easy.

The first thing you’ll want to do is configure Windows to play nicely with your multiple monitors. If you’re running Windows 7, right-click on the desktop and click Screen Resolution. This will take you to the Screen Resolution menu, where you’ll be able to configure what limited options you have for multiple monitors in Windows 7.

Here, you can see your setup, identify your monitors (click this and you’ll see large numbers appear on your screens, so you can identify which screen is which), and choose your main display. You can also choose whether to duplicate your desktop or extend your desktop between the screens. In most multi-monitor setups, you’ll want to extend your desktop across all three (or more) of your displays.

If you’re running Windows 8, you have more options (go.pcworld).

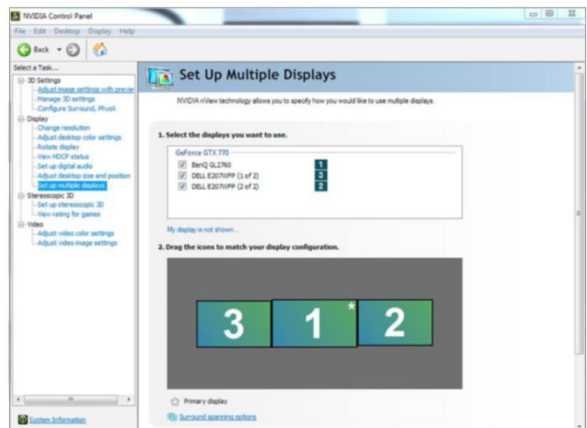
Configure your displays in the Screen Resolution menu.



com/win8) for your multi-monitor setup: You can extend the taskbar across displays and assign different wallpapers to each screen without using third-party software.

Windows 7 users will need to use third-party software such as DisplayFusion or MultiWall to accomplish this. In Windows 8, you'll also notice more intuitive mouse movement across your monitors, and all corners and edges will be active so you can access your Charms bar and other apps from any screen.

In addition to Windows' multi-monitor configurations, there's also Nvidia's and AMD's



You can also use Nvidia's or AMD's control panels to adjust your monitor setup.



control panels (depending on which type of graphics card you have). To access Nvidia's control panel, right-click the Nvidia icon in your System Tray and click Nvidia Control Panel. Under Display, click Set Up Multiple Displays. Here, you'll be able to fiddle around with your monitor setup as well as set up Nvidia Surround.

To access AMD's control panel, open the Catalyst Control Center in your System Tray and go to *Graphics → Desktops & Displays* to configure your multi-monitor setup. Here, you can create an Eyefinity group, which lets you set up a desktop to span multiple displays in any configuration.

Gaming


It's one thing to use multiple monitors to do work and watch Netflix. It's another thing entirely to use multiple monitors to play video games. If you want to use your snazzy new multi-monitor setup to do some three- or four-panel gaming, there are a few extra things you'll have to take into consideration.

Gaming on several displays at once requires far more graphical firepower than gaming on a single screen alone, because the GPU has so many more pixels to push—so if you're not running multiple graphics cards in an SLI or Crossfire setup, you'll almost certainly see lag and artifacting in your multi-monitor games. Quite simply, a single

graphics card usually doesn't have the power to run multiple high-resolution, high-intensity displays at once (although some do—check out our graphics card showdown [go.pcworld.com/gcshowdown]).

Before you can start playing your games across multiple panels, you'll need to set up your graphics card and your game. Nvidia users will need to set up Nvidia Surround, while AMD users will need to create an Eyefinity group for their monitors.

You'll also need to go into your game (not all games are multi-monitor-compatible) and configure the video or display settings to the correct resolution so that the game spans across all of your monitors instead of staying squished on just one. You'll also want to play around with other settings as the game allows, including field of view (too low, and there will be too much going on around you; too high, and everything on your left and right screens will be hugely distorted).

For gaming, it's easier if you have multiple identical displays, because otherwise you'll run into issues with resolution, distortion (if your displays aren't at the same height), and color calibration, all of which can be difficult to work with if you're trying to play in a "seamless" environment. 

For gaming, it's easier if you have multiple identical displays.



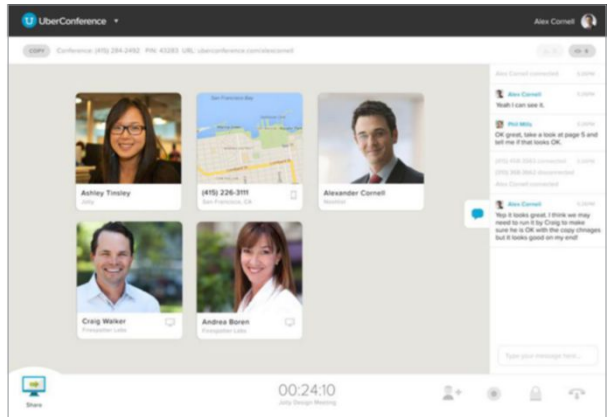
4 essential Google Drive add-ons

BY MICHAEL ANSALDO

ADD-ONS ARE A great way to give Google Drive's productivity suite a little more horsepower. These four offer creative solutions for collaborating, automating document workflow, and mapping data and ideas. Give them a try, and push your productivity to new levels.

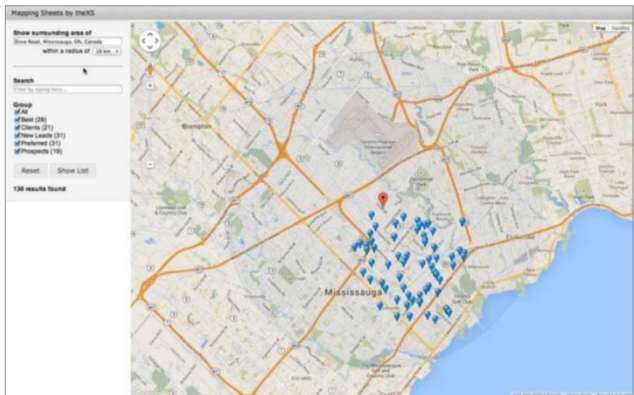
Uberconference

By its nature, Google Docs is a collaboration tool. The Uberconference add-on extends its power by getting all a document's contributors together on a conference call right within the doc itself. Once you launch the add-on, click to invite participants and a list of the document's viewers and editors will appear in its right sidebar. You can edit the list of participants before you invite them. Once they join, you'll all be able to hear and see each other as you work on your document and even record the call for later review.



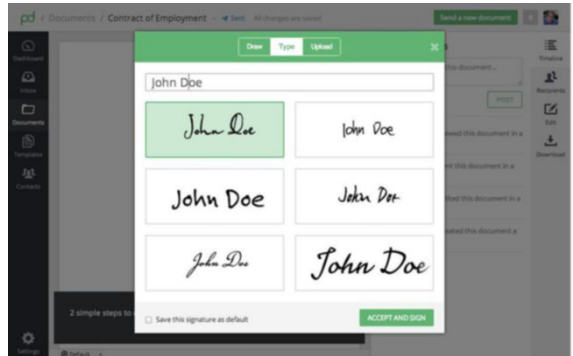
Mapping Sheets

Imagine if you could see all your contacts, appointments, or other location-based data in a spreadsheet plotted out together on a map. That's exactly what the Mapping Sheets add-on lets you do. With just a few clicks, it will take the addresses from any Google Sheet and create a Google Map from it. From there, you have access to all of Google Map's searching and filtering tools, so you can narrow your focus to a geographic area, review details of a specific location, and more.



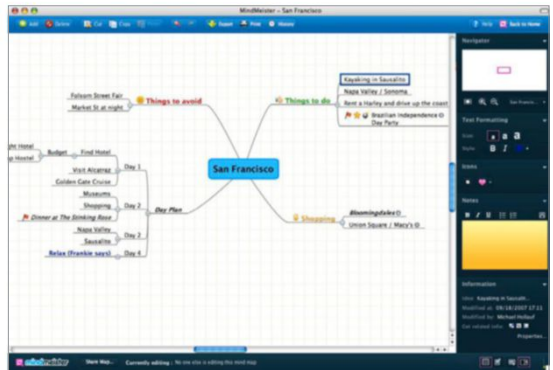
PandaDoc

Though almost all document transactions are handled digitally now, signature requirements can still muck up the process. PandaDoc lets you keep your document workflow online by adding e-signature capability to Google Docs. Just click the Recipient icon in your PandaDoc add-on and select an existing PandaDoc contact or create a new one. Next, add the appropriate PandaDoc widgets—electronic signature, checkboxes, initials, text fields, and date are your options—to the document and send it to get the recipient's legally binding electronic signature.



MindMeister

Mind maps—diagrams that connect information around a central topic—are a powerful way to develop and visualize ideas. The MindMeister add-on will turn any bulleted list in Google Docs into a mind map with a few clicks. Just make a list, select the text, and then select MindMeister from the Add-ons drop-down menu within your document. Click Insert As Mind Map, and a mind map will be generated using the first list item as the root topic. First-level points are transformed into first-level topics, and so on. When the mind map is finished, it will appear right beneath your list. You can delete the original text list and place the mind map wherever you want it in the document. 🖱️





Secure your home network in 3 simple steps

BY ROBERT LEMOS

IN 2014, COMPANIES announced a security breach nearly every day (go.pcworld.com/threatreport), exposing an average of 1.1. million identities per breach.

For consumers, the news appears grim. From ads on major websites

infecting consumers' systems to ransomware that can hold data hostage, criminals continue to successfully steal money and data from half a world away. If companies can't protect themselves from the bad guys, what chance do individual users have? Even the police are falling prey (go.pcworld.com/policeransomware) to criminals.

In reality, consumers have a better chance than most companies. Yes, home users are overwhelmingly targets of opportunity, but they can protect themselves by making their systems harder to compromise and looking out for signs of infections.

"You can't just pack it up and give in, even though that may seem to be a reasonable approach," says Mark Nunnikhoven, senior research scientist with OpenDNS. "You need to take reasonable steps to protect yourself."

For years, security professionals have tried to erect impenetrable digital walls, but that strategy has largely failed. Instead, the latest philosophy focuses on throwing up multiple hurdles in front of attackers and improving awareness—spotting attacks before they can do damage.

For consumers, these techniques boil down to three simple strategies.

1. Don't leave a device vulnerable

With the average person carrying three devices—a smartphone, a tablet, and a desktop or laptop—keeping track of whether all those devices have downloaded the latest updates is a chore. Multiply the workload by the number of family members and keeping up with updates can be an enormous and ongoing project.

A few security services can help the family administrator manage the problems. For Windows users, Secunia's Personal Software Inspector (go.pcworld.com/secuniafeatures), a free service, checks all



1 IN 4 USERS ADMITTED THEY DID NOT KNOW WHAT THEY AGREED TO GIVE ACCESS TO ON THEIR PHONE WHEN DOWNLOADING AN APPLICATION.

SOURCE: SYMANTEC

third-party software for updates and gives instructions on how to update. For hybrid households, OPSWAT Gears (opswatgears.com), a free service for less than 25 devices, makes sure that each PC and Mac passes a number of security checks, such as whether it has antivirus protection, a firewall, and an encrypted hard drive.

“We get you a score for compliance and then we give you the tools to improve your score, either based on systems configuration or third-party applications,” says OPSWAT CEO Benny Czarny.

In addition, most major security software makers have made managing multiple devices much easier, albeit for a fee.

2. Monitor your network's traffic

Once your systems are locked down, the next step is to monitor the network for potentially bad traffic. To compromise your computers, attackers must communicate with your network, and that leaves traces.

The Linksys WRT1900AC is one example of a consumer router with advanced logging features.



One option: Look at the logs captured by the network router. More advanced routers—including many high-end consumer models and most models designed for small-

business use, have options for logging or even for archiving of logs in the cloud. Another option is to use a cloud service, such as OpenDNS (opendns.com), which collects all the domain requests generated by your users, blocking communications to suspect servers and websites and allowing family administrators to filter inappropriate traffic.

“You want to have more visibility into what is going on in your network,” says OpenDNS’s Nunnikhoven. “That means that you can look at each one of those devices in turn or you can try to go up a level and look at the overall network visibility.”

You want to have more visibility into what is going on in your network.

3. Check outbound traffic

Finally, having a firewall turned on and protecting your computer from outside threats is a no-brainer. But for consumers who want more protection, an outbound firewall—such as Little Snitch (obdev.at/products/littlesnitch) for Mac OS X and GlassWire (glasswire.com) on Windows—can alert them to potentially malicious applications trying to connect out to the Internet.

Outbound firewalls, on the other hand, have a somewhat noisome learning curve. Every time an application attempts to communicate with the Internet, the user must allow or deny the request. The firewall will remember the answers for the future, but it generally takes a few days to get to a point where the firewall is not inundating the user with alerts.

Still, the effort can pay off, says Nunnikhoven.

“There is no magic bullet for security,” he says. “But with a few relatively low-cost tools, you can create a good layered defense.” 🔒



How to download your Google search history

BY IAN PAUL

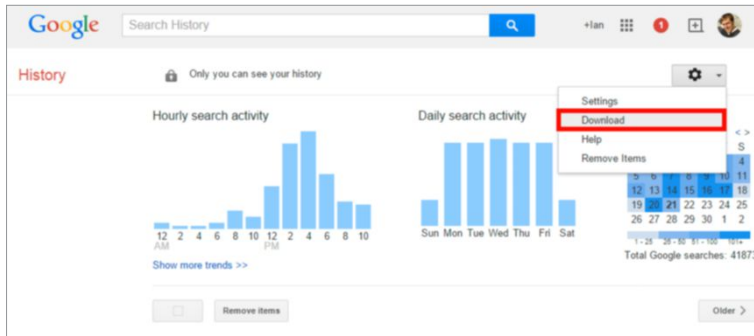
GOOGLE RECENTLY ADDED another option to its Takeout service that lets you export data from your Google account, and the latest addition is one of the most important: Your Google search history.

Next to email, there's nothing in your Google account that's more revealing than your search history. Your personal collection of keywords can reveal the status of your personal relationship, the last time you were sick, if you're looking for a career change, and where you're planning to go on vacation.

There isn't much you'll be able to do with your search history unless you're a developer, as the archive is just a collection of JSON files ([file.org/extension/json](#)). Over time, however, other search services may let you import your Google search history. Here's how to get exporting.

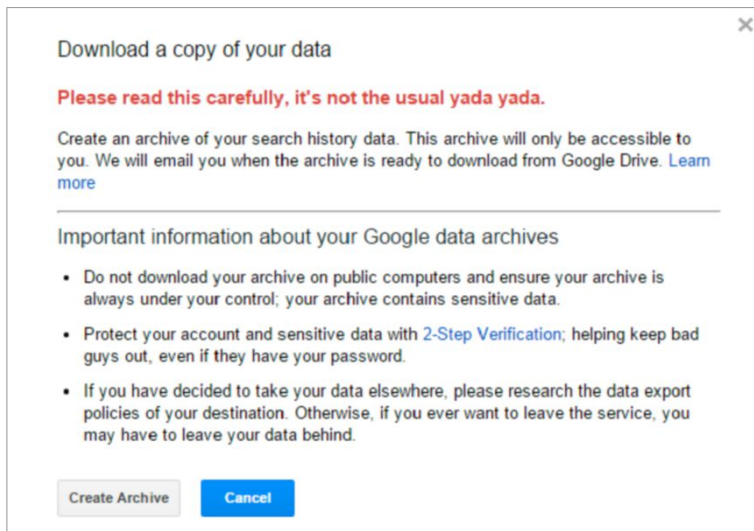
Where to go

Google hasn't added search to its Takeout dashboard yet, so you'll have to go to the Google History (google.com/history) page to grab your search archive, as first noted by the Google Operating System blog.



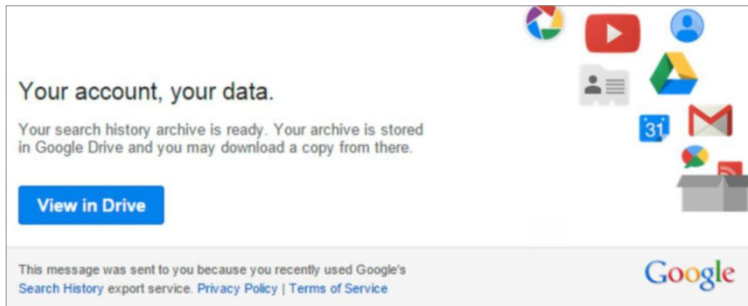
Google's
history
dashboard.

Once you're there and signed in to your account, click on the settings cog in the upper right corner and select Download.



Google offers
some warnings
before creating
your search
archive.

Next, you'll see a pop-up window with a bunch of information about your archive. Google warns that users should read the whole disclaimer as "it's not the usual yada yada"—a phrase Google typically uses for security- and privacy-related issues.



The warnings, however, are


mostly common sense security measures: don't download your archive on a public computer, don't lose control of your search archive, and protect your Google account with 2-step verification so that no one else can try and download your search history.

Google also warns anyone importing their data into a new service that they should make sure that third-party also lets you export your data. Otherwise, your data will end up stuck in the new service with no way to export it.

Once you're comfortable with all of Google's warnings, hit Create Archive at the bottom of the window. Google will now generate your archive and notify you by email when it's ready.

How long it will take to get that email depends on the size of your archive. Once the email arrives it will let you know you can view the files that make up your search history in Drive, or you can download them directly from Gmail.

Google creates a new Drive folder called Takeout where you can always grab your generated search archive or download it. As we mentioned earlier, there's not much to see and opening the HTML file included in the archive only shows you a summary of the JSON files in your search history.

That's about all there is to downloading your search history. Give it a try. 

This is the message you'll see once your search history is ready.



Firefox extension kills problem of noisy web pages hiding in tabs



I END UP talking a lot about Chrome extensions and apps partly because it's the browser I use every day, and partly because so much active development is happening on Chrome. But today I've got a great tool for all the Firefox users out there who open a lot of tabs at once or are tired

of videos autoplaying in tabs that aren't the main focus.

The Firefox add-on Open Link In Silent Tab (go.pcworld.com/ffsilenttab) gives you the option to open a tab without loading the corresponding

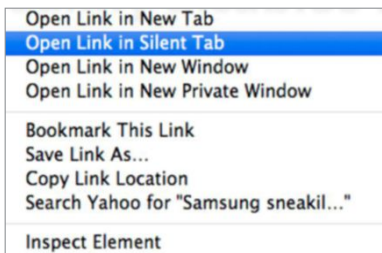
webpage. Once you switch to that tab, the page automatically loads. The downside to this is that it will slow down your browsing a bit since you'll have to wait for the page to load. But it also makes it easier to have multiple tabs open without slowing down the whole program, and it means you don't have a bunch of autoplaying videos going off at once.

To start, you'll have to download and install the add-on from Mozilla's add-on gallery. Once it's installed, the add-on should start working right away.

To test it, right-click any link and you should see an option in the contextual menu that reads Open Link In Silent Tab. Pick that and a new tab opens almost immediately without loading the page. Click on the new tab and the page will load right away.

If you are a fan of shortcuts rather than right-clicking, there are options to use mouse-keyboard shortcuts instead, such as Ctrl + Alt + left-click.

What it doesn't have is an option to make opening the page in silent mode the default behavior. If that's more appealing, then try Load Tab On Select (go.pcworld.com/ffloadtab) by the same developer. 🔥



The Open Link
in Silent Tab
add-on places a
new option in
your context
menu.



How to find the secret Start Menu built into Windows 8.1

It's not exactly the classic Start menu, but it's close enough. Here's the trick that makes it appear.

I USUALLY ADVISE readers, but this time a reader gave me advice. Joe Rubenstein told me that “There is a Start Menu in Windows 8.1,” then explained how to make it work.

Yes, it's true. You can add a Start menu—of sorts—to the Windows

8.1 taskbar without installing a third-party program. All of the code is built into Windows itself.

Three caveats: First, it's too small for touchscreens; you'll need a mouse. Second, Metro/Modern apps can't launch from this menu. And finally, it doesn't work with Windows 8.0. (Oddly, it works in Windows 7, where it's completely redundant.)

To make the menu appear, you must first unhide hidden files. Open File Explorer. Click the View tab, and check Hidden Items in the Show/Hide section.

Right-click the taskbar and select *Toolbars* → *New Toolbar*. This brings up File Explorer, where you should navigate to `C:\ProgramData\Microsoft\Windows\Start Menu\Programs`. Once there, click *Select Folder*.

If you wish, you can now hide the no-longer-hidden files. Just recheck the Hidden Items option.

The new toolbar, named *Programs*, will appear on the right side of the taskbar, immediately to the left of the notification area. Click the chevron to the right of the word *Programs* to bring up the menu.

You'll see a few programs directly on the menu. The rest of your old-fashioned desktop programs will be in the various submenus.


The submenus are actually subfolders inside the Programs folder (and the programs are actually shortcuts). If you want to create an additional submenu, right-click the Programs toolbar and select *Open Folder*. Then create a new folder.

But you don't need to open the folder to make other changes. You can rearrange the menu by dragging items up and down, or dragging



them in and out of submenus.

Obviously, you'll want your favorite programs on the main part of the menu, rather than in a submenu. By default, three Metro/Modern apps are located in the main menu, even though you can't launch them from there.

The obvious way to fix that problem is to delete those three shortcuts. But that seemed to confuse Windows, and caused problems. So, instead, create a submenu called Ignore Me, and drag those three shortcuts to that folder. 



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Tech Spotlight

A video showcase of
the latest trends



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video at
[go.pcworld.com/
picobrewvid](http://go.pcworld.com/picobrewvid)



PicoBrew Zymatic: Craft beer in a cloud-connected appliance

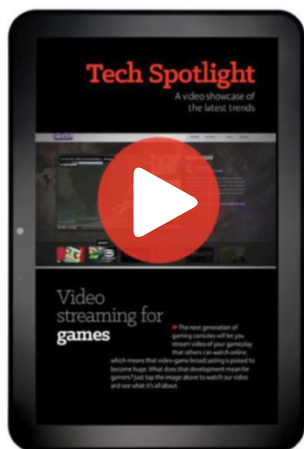
» The Zymatic is not like an espresso machine or Sodastream for beer, so if you're looking for instant gratification (let alone an instant buzz), just buy a six-pack instead. Beer brewing is typically a one- to three-week operation that involves big pots and buckets, precision temperature control, and strict respect for sanitization and other best practices. The Zymatic streamlines much of this rigmarole, but it's not a miracle worker, so you'll still need to wait quite a while for your beer.

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